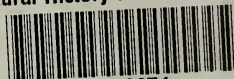


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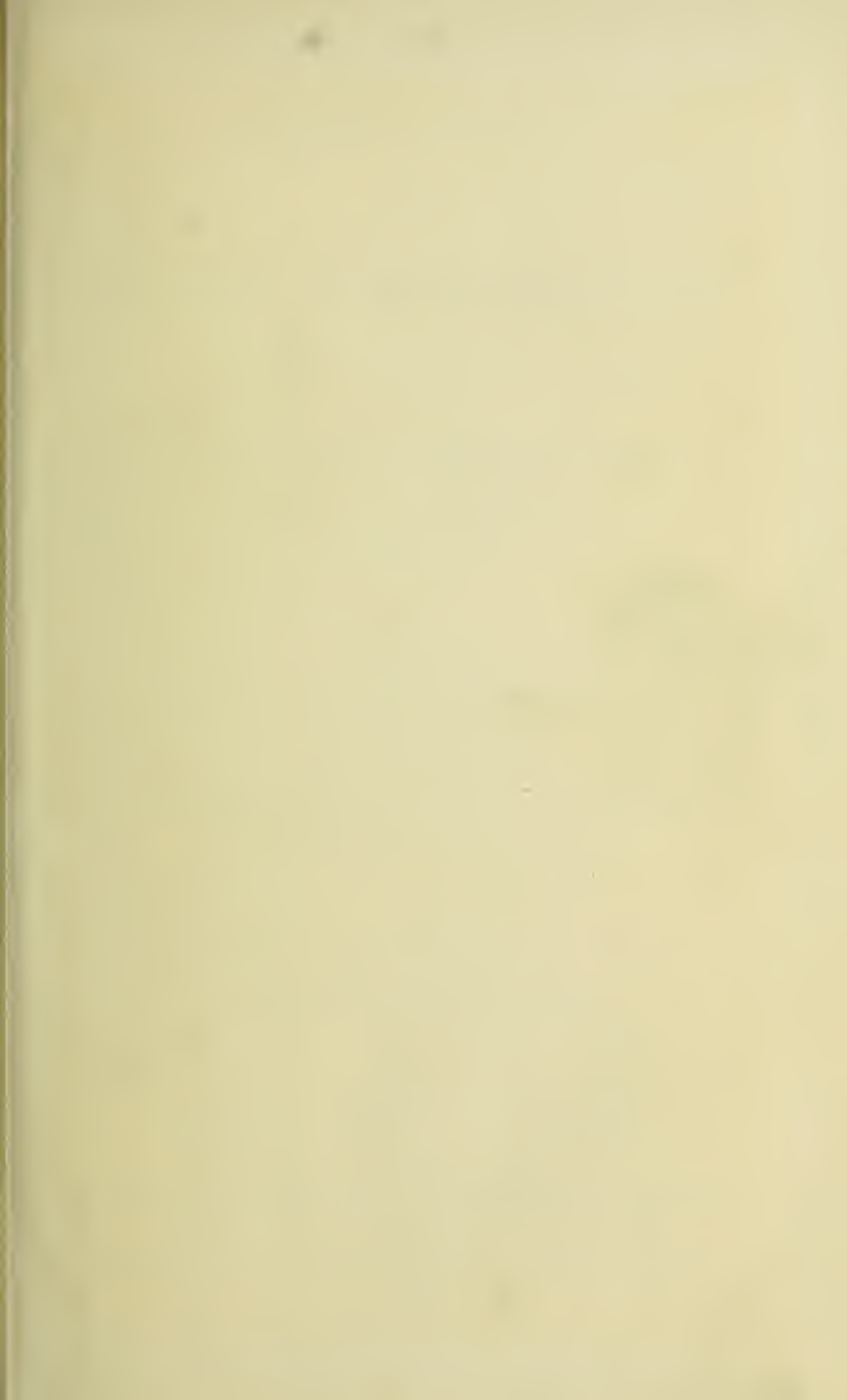
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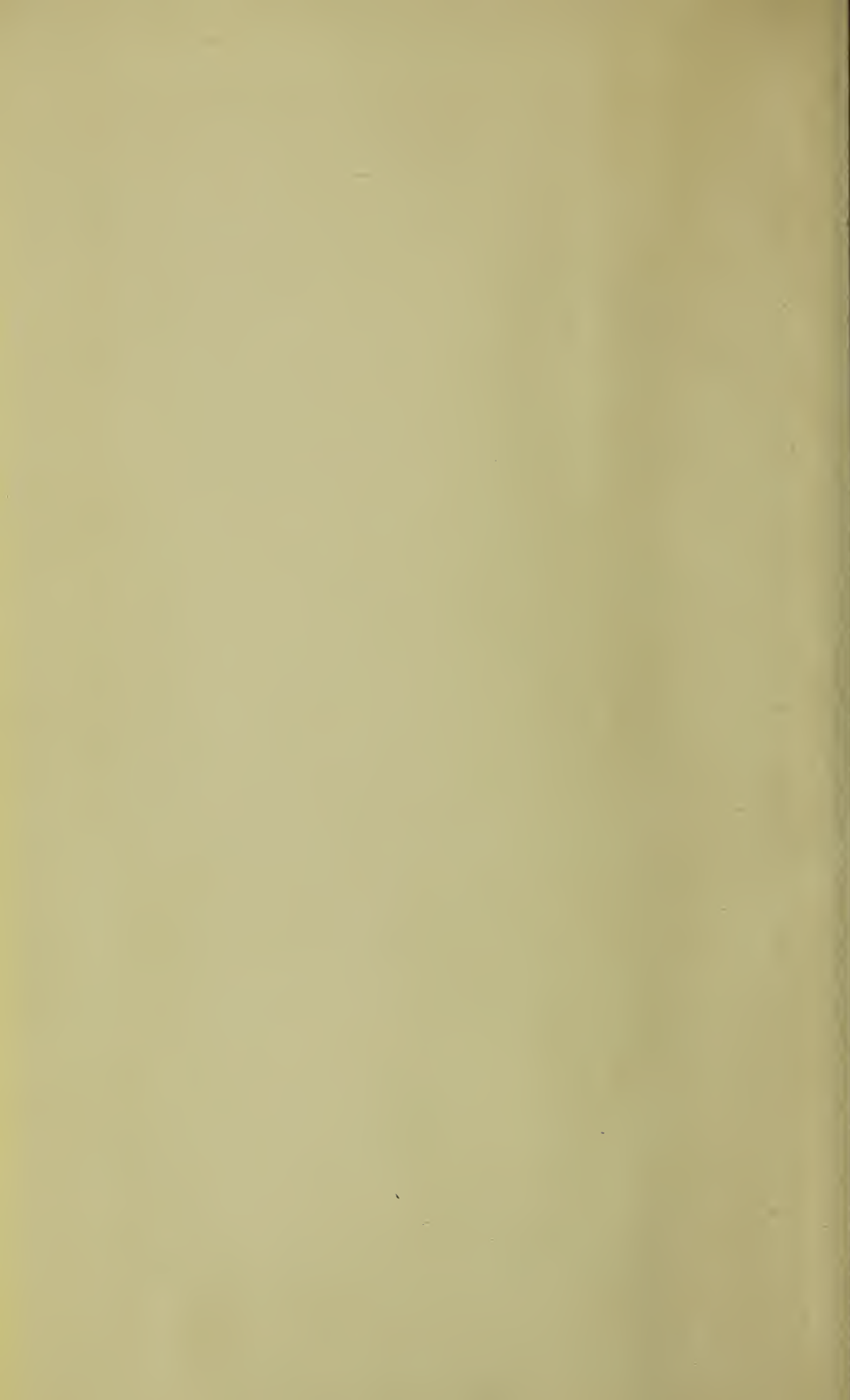
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CATALOGUE
OF THE
FOSSIL CEPHALOPODA

IN THE
BRITISH MUSEUM
(NATURAL HISTORY),
CROMWELL ROAD, S.W.

PART II. *h with I.*

CONTAINING THE REMAINDER OF THE SUBORDER
NAUTILOIDEA,
CONSISTING OF THE FAMILIES
LITUITIDÆ, TROCHOCERATIDÆ, AND NAUTILIDÆ,
WITH A SUPPLEMENT.

BY
ARTHUR H. FOORD, F.G.S.

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PREFACE.

Two years have elapsed since the completion of Part I. of Mr. Foord's Catalogue: during that time he has been almost entirely occupied in the preparation of the present volume.

So anxious has he been to make his work as complete and satisfactory as possible, that he has visited the Museums of Brussels and Munich, besides very many public and private collections in this country, to see every type which might assist him in drawing up his descriptions. Fortunately the number of type-specimens in the British Museum is very large, so that he has enjoyed special facilities for study and comparison on the spot, and many specimens have been lent to him by other Museums.

The number both of illustrations and of pages in Part II. are larger than in Part I., and the Tables of Genera and of Stratigraphical equivalents add much to the usefulness of the present volume. From the former Table (A) we gather that there are in the Museum 573 species included in the NAUTILOIDEA, of which 459 are met with in the Palæozoic rocks,*93 in the Mesozoic, and 21 in the Cainozoic strata—the Palæozoic forms being divided into 29 genera and 6 subgenera, the Mesozoic into 4 genera and 2 subgenera; in the Cainozoic only 2 genera and 1 subgenus are met with, whilst at the present day *Nautilus* alone survives.

The variation in their forms, and the number both of genera and species in the Palæozoic rocks, attest the long lapse of ages which this period represents; their rapid diminution in the Neozoic period, both in numbers and variation of form, bespeaks the dying-out of this ancient and once dominant type.

The chapter at the close of this volume on "Rhyncholites," or mandibles of Nautili, will prove very useful to palæontologists. These bodies are so often found separately in rocks dissociated from the other remains of the animal of which they once formed a part that their true species cannot readily be determined; yet in a few instances they occur within the body-chamber of the animal's shell, and so can be identified with certainty, as in the case of *Nautilus Libanoticus* (p. 371).

Mr. Foord's excellent figures (drawn by himself) greatly enhance the value of this Catalogue, which, with its ample bibliographical references, deserves to find a place in every scientific library.

HENRY WOODWARD.

British Museum (N. H.),
Department of Geology,
February 12th, 1891.

INTRODUCTION.

Up to the time that Professor Hyatt's preliminary memoir upon the Fossil Cephalopoda appeared (1883)¹, no serious attempt had been made to separate the Nautilidæ into distinct genera, the divisions accepted by palæontologists being those of Quenstedt² or some modification of his system. Although d'Orbigny³, M'Coy⁴, and Meek and Worthen⁵ established a few groups—*Cryptoceras*, *Discites*, *Temnocheilus*, *Trematodiscus*, *Solenocœilus*, &c.—these were generally held to be merely of subgeneric value, and by some authors, notably de Koninck⁶ and W. Waagen⁷, they were rejected altogether.

Professor Blake⁸ has separated the Nautiloidea into four groups—*Conici*, *Inflati*, *Spirales*, *Irregulares*—of which *Nautilus* and *Gyroceras* constitute Group III. (*Spirales*), *Clymenia*, *Discites*, *Nothoceras*, and *Aturia* being treated as subgenera of *Nautilus*.

Mojsisovics⁹ has divided the Triassic forms into groups, some of which are equivalent to those of M'Coy and of Meek and Worthen, while others (*Pleuromytilus* and *Clydonomytilus*) are his own. He appears to have been the first to endeavour to trace out the development in time of a series of these forms, particularly in the case of *Pleuromytilus* (*infra*, p. 135).

¹ Proceed. Boston Soc. Nat. Hist. 1883, vol. xxii. p. 253.

² Petrefactenkunde Deutschlands, Band i. 1846-49, pp. 52-60.

³ Prodr. de Paléontologie Stratigraphique, 1849, vol. i. p. 114.

⁴ Synop. Carboniferous Foss. Ireland, 1844.

⁵ Proc. Acad. Nat. Sci. Philadelphia, 1861, p. 147 (*Trematodiscus*). Ibid. 1870, p. 47 (*Solenocœilus*).

⁶ Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, vol. ii.), pt. i. 1878, p. 85.

⁷ Mem. Geol. Surv. India—Palæont. Indica—ser. xiii. vol. i. pt. i. May 1879, p. 43.

⁸ British Fossil Cephalopoda, pt. i. 1882, p. 47.

⁹ Die Cephalopoden der Mediterranen Triasprovinz (Abhandl. d. k.-k. geol. Reichsanst. Band x.), 1882, pp. 265-290.

It will here be useful, for the sake of comparison, to tabulate the divisions of the Nautiloids adopted by different palæontologists.

Quenstedt's divisions are the following¹ :—

1. *Imperfecti*.—For those in which the whorls are only slightly involute. The following species are cited as examples, viz. *Nautilus ingens*, Martin (= *N. [Solenocœilus] pentagonus*, J. Sow.), *N. [Cœlonautilus] cariniferus*, J. de C. Sow., *N. [Cœlonautilus] multicarinatus*, J. de C. Sow., &c.
2. *Moniliferi*.—With beaded siphuncle. Ex. *Nautilus [Temnocheilus] bidorsatus*, Schloth., *N. [Temnocheilus] nodosus*, Münst.
3. *Bisiphites*.—For those with an internal (dorsal) lobe. Ex. *Nautilus aratus*, Schl. (= *N. striatus*, J. Sow.).
4. *Simplices*.—For those with smooth or finely striated shells. Ex. *Nautilus lineatus*, J. Sow., *N. imperialis*, J. Sow., &c.
5. *Undulati*.—For those with transverse costæ. Ex. *Nautilus elegans*, J. Sow., *N. radiatus*, J. Sow.
6. *Aganites*.—For those with deeply-lobed sutures. Ex. *Nautilus [Hercoglossa] aganiticus*, Schloth., *N. [Aturia] Aturi*, Basterot, &c.

It will be unnecessary to discuss the relations of these groups, which are manifestly of unequal value, further than to say that the first (*Imperfecti*) consists of Carboniferous species, and the others include the remainder of the *Nautilus*-like forms, ranging from the Trias to the Eocene.

D'Orbigny² proposed the three following divisions for the Nautili of the Secondary rocks :—

1. *Striati*.—Composed of species with longitudinal striations in the adult. Ex. *Nautilus striatus*, J. Sow., *N. intermedius*, J. Sow., &c., of the Jurassic.
2. *Riadiati*.—Composed of species with transverse plications or grooves in the adult. Ex. *Nautilus plicatus*, Fitton, *N. pseudo-elegans*, d'Orb., *N. radiatus*, J. Sow., *N. elegans*, J. Sow., &c., of the Cretaceous. This group is equal to *Cymatoceras* of Hyatt³, in part.

¹ Petrefactenkunde Deutschlands, Bd. i. Cephalopoden, 1846-49, pp. 52-60.

² Paléontologie Française—Terrains Jurassiques, 1842, tom. i. p. 145.

³ Proc. Boston Soc. Nat. Hist. 1883, vol. xxii. p. 301.

3. *Lævigati*.—Without either longitudinal or transverse striae in the adult. Ex. *Nautilus latidorsatus*, d'Orb. (= *N. Toarcensis*, d'Orb.), *N. inornatus*, d'Orb., *N. truncatus*, J. Sow., *N. excavatus*, J. de C. Sow., *N. lineatus*, J. Sow., &c., of the Jurassic rocks, and *N. Bouchardianus*, d'Orb., *N. Clementinus*, d'Orb., *N. sublævigatus*, d'Orb., of the Cretaceous.

These divisions are eminently artificial, because they do not take into account the form of the shell, that of the umbilicus, or the position of the siphuncle, all which characters must be reckoned with, if a natural classification is aimed at.

De Koninck, in his work on the Carboniferous fossils of Belgium¹, makes the following divisions:—

1. *Globosi* (= *Ephippioceras*, *Cælonutilus*, &c.).—Including *Nautilus bilobatus*, J. Sow., *N. globatus*, J. Sow., *N. crassiventer*, de Kon., &c.
2. *Atlantoidei*.—For *Nautilus Atlantoideus*, de Kon., *N. neglectus*, de Kon., &c.
3. *Serpentini* (= *Cælonutilus*, *Solenocœilus*, &c.).—*Nautilus Coynanus*, d'Orb., *N. biangulatus*, J. Sow. (non d'Orbigny), *N. implicatus*, de Kon., *N. ingens*, de Kon. (non Martin), *N. pentagonus*, J. Sow., *N. elephantinus*, de Kon., *N. dorsalis*, Phill., *N. cyclostomus*, Phill., &c. This is the largest group, and contains fourteen species.
4. *Tuberculati* (= *Solenocœilus* and *Temnocœilus*).—Consisting of only three species, viz. *Nautilus bifrons*, de Kon., *N. coronatus*, M'Coy, *N. latus*, Meek and Worthen.
5. *Disciformes* (= *Discites*, pars).—*Nautilus planotergatus*, M'Coy, *N. difficilis*, de Kon., *N. trochlea*, M'Coy, *N. mutabilis*, M'Coy, *N. exaratus*, de Kon., &c.
6. *Lenticulares* (= *Phacoceras* &c.).—Contains only two species, *Nautilus oxystomus*, Phill., *N. complanatus*?, J. Sow.
7. *Sulciferi* (= *Cælonutilus* &c.).—*Nautilus sulcatus*, J. Sow., *N. Edwardsianus*, Phill., *N. subsulcatus*, Phill., *N. discoideus*, de Kon.
8. *Cariniferi* (= *Cælonutilus* &c.).—*Nautilus cariniferus*, J. de C. Sow., *N. pinguis*, de Kon., *N. multicarinatus*, J. de C. Sow., *N. Meyerianus*, de Kon., &c.

¹ Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), 1878, pt. i. p. 90.

9. *Ornati* (= *Discites* &c.).—Containing three species, viz. *Nautilus discors*, M'Coy, *N. Leveilleanus*, de Kon., *N. ornaticissimus*, de Kon.

In this arrangement the form of the shell in nearly all the divisions is taken as the basis of the classification, which thus approaches nearer to a natural one than d'Orbigny's. Exception, however, must be taken to Group 9, *Ornati*, which is not of equal value with the other groups, and includes species whose shell-characters indicate very clearly their alliance with Group 5, *Disciformes*. (See *infra*, pp. 86–96.)

It may be mentioned that a careful diagnosis of the characters of all the species comprised in the above groups is given in de Koninck's table, under the following headings, viz.: General Form; Surface, Spire, Transverse Section; Umbilicus, Sutures; Siphuncle.

The following groups are adopted by Mojsisovics¹ in his work on the Alpine Trias:—

Family NAUTILIDÆ.

- | | | |
|----------------------------------|---|-------------------------------|
| (a) Subfamily GYROCERATINÆ | { | <i>Temnocheilus</i> . |
| | | <i>Trematodiscus</i> ? |
| | | <i>Pleuromutilus</i> (Mojs.). |
| (b) Subfamily NAUTILINÆ | { | <i>Nautilus</i> . |
| | | <i>Clydonutilus</i> (Mojs.). |

The following Families³ of the Nautiloidea, and many of the genera comprised in the former, were proposed by Professor Hyatt in his 'Genera of Fossil Cephalopods' (1883). I have here transcribed only those Families which include genera treated of in the present volume, such genera being distinguished by an asterisk. Beginning with the Hercoceratidæ ('Genera Foss. Ceph.' p. 282), all the families are given in the same order as in Hyatt's memoir, except that I have added at the beginning his provisional Family, *Tainoceratidæ*, placed by him under the heading "Incertæ Sedis" ('Genera Foss. Ceph.' p. 267). This Family is included by Hyatt (with a reservation as to some of the genera) in his division *Holochanoida*⁴, and immediately succeeds the *Endoceratidæ* in his

¹ Die Cephalopoden der Mediterranen Triasprovinz (Abhandl. d. k.-k. geol. Reichsanst. Band x.), 1882, pp. 265–290.

² See *Calonutilus*, *infra*, p. 105.

³ Excepting, of course, the *Nautilidæ*.

⁴ See Part I., Introduction, p. v.

memoir. I should add that *Gonioceratidæ* (Hyatt), containing the one genus *Goniceras*, is omitted, as it was dealt with in Part I. (Suppl. p. 322). Hyatt places the *Gonioceratidæ* between *Eudoceratidæ* and *Apsidoceratidæ*.

TAINOCERATIDÆ, Hyatt, 1883.

- **Trocholites*, Conrad. Type, *T. ammonius*, Conrad, Ann. Geol. Rep. p. 119 (1838). (*Fide* Hall, Pal. New York, vol. i. p. 192 (1847).)
- Plectoceras*, Hyatt. Type, *Nautilus Jason*, Billings, Canadian Naturalist and Geologist, vol. iv. p. 464 (1859).
- Litoceras*, Hyatt. Type, *Nautilus versutus*, Billings, Palæoz. Foss. vol. i. p. 259 (1865).
- Diadiploceras*, Hyatt. Type, *D. quadratum*, Hall (apparently not described); or ? *Discites inopinatus*, Hall, Pal. New York, vol. v. pt. ii. pl. cx. (1879).
- Metacoceras*, Hyatt. Type, *Nautilus Sangamonensis*, Meek and Worthen, Geol. Surv. Illinois, vol. ii. pl. xxix. (1866).
- Tainoceras*, Hyatt. Type, *Nautilus quadrangulus*, McChesney, Trans. Chicago Acad. vol. i. pl. iii. figs. 5-7 (1866).
- Mojsvaroceras*¹, Hyatt. Type, *Temnocheilus Neumayri*, Mojsisovics, Mediterr. Triasprov. pl. lxxxviii. (1882).
- Grypoceras*, Hyatt. Type, *Nautilus mesodiscus*, Hauer, Ceph. des Salzkammergutes, Taf. x. figs. 4-6 (1846).
- **Clydonautilus*, Mojsisovics. Type, *C. Noricus*, Mojsisovics, Mediterr. Triasprov. p. 281 (1882).
- Enclimatoceras*, Hyatt. Type, *Nautilus Ulrichi*, White, Bull. United States Geol. Surv. vol. i. no. 4, pls. vii., viii., ix. (1884).
- **Hercoclossa*, Conrad. Type, *Nautilus orbiculatus*, Tuomey, Proceed. Acad. Nat. Sci. Philadelphia, p. 167 (1855).
- **Aturia*, Bronn. Type, *Nautilus Aturi*, Basterot, Descrip. des Coq. Foss. des Environs de Bordeaux, Mém. Soc. d'Hist. Nat. de Paris, vol. ii. pt. i. p. 17 (1825).

HERCOCERATIDÆ, Hyatt, 1883.

- Plyssoceras*, Hyatt. Type, *Cyrtoceras alienum*, Barr. Syst. Sil. Boh. vol. ii. pl. cxxvii. (1866).
- **Hercoceras*, Barrande. Type, *H. mirum*, Barr. Syst. Sil. Boh. vol. ii. pl. xlii. (1865).
- Anomaloceras*, Hyatt. Type, *Nautilus anomalus*, Barr. Syst. Sil. Boh. vol. ii. pl. xxxiv. (1865).
- **Temnocheilus*, M'Coy. Type, *T. coronatus*, M'Coy, Synop. Carb. Foss. Ireland, pl. iv. fig. 15 (1844).
- **Centroceras*, Hyatt. Type, *Nautilus (Discites) Marcellensis*, Hall, Pal. New York, vol. v. pt. ii. pls. lxx., cix. (1879).

¹ Altered to *Mojsisoceras* by Dr. K. A. Zittel, Handbuch der Palæontologie, Band i. Abth. ii. Lief. iii. p. 381.

RUTOCERATIDÆ, Hyatt, 1883.

- Zittelloceras*, Hyatt. Type, *Cyrtoceras lamellosum*, Hall, Pal. New York, vol. i. pl. xli. (1847).
Halloceras, Hyatt. Type, *Gyroceras undulatum*, Hall, Pal. New York, vol. v. pt. ii. pls. liii., liv. (1879).
Rutoceras, Hyatt. Type, *Cyrtoceras Jason*, Hall, Pal. New York, vol. v. pt. ii. pl. l. (1879).
Triplooceras, Hyatt. Type, *Nautilus insperatus*, Barr. Syst. Sil. Boh. vol. ii. pl. cccclxi. (1877).
Adelphoceras, Barrande. Type, *A. Bohemicum*, Barr. Syst. Sil. Boh. vol. ii. pl. cccclix. (1870).
Kophinoceras, Hyatt. Type, *Cyrtoceras ornatum*, d'Arch. and de Vern. Trans. Geol. Soc. vol. vi. pt. ii. pl. xxviii. (1841).
Strophiceras, Hyatt. Type, *Gyroceras binodosum*, G. & F. Sandberger, Verstein. Nassau, pl. xii. (1850-56).
Solenoceras, Hyatt. Type, *Nautilus canaliculatus*, Cox, in Owen, Geol. Kentucky, vol. iii. p. 575, pl. x. (1857).
Phloioceras, Hyatt. Type, *Nautilus gemmatus*, Mojsisovics, Das Gebirge um Hallstatt, pl. iii. (1873).
**Pleuromutilus*, Mojsisovics. Type, *P. trinodosus*, Mojs. Mediterr. Triasprov. pl. lxxxv. (1882).

EUDOCERATIDÆ, Hyatt, 1883.

- Eudoceras*, Hyatt. Type, *Trochoceras*? (*Gonioceras*?) *pandum*, Hall, Pal. New York, vol. v. pt. ii. pl. cxi. (1879).
Tripteroceras, Hyatt. Type, *Orthoceras hastatum*, Billings, Rep. Prog. Geol. Surv. Canada, 1853-1856, p. 333 (1857).
Edaphoceras, Hyatt. Type, *Nautilus (Temnocheilus) Niotensis*, Meek and Worthen, Geol. Surv. Illinois, vol. v. pl. xix. (1873).
Endolobus, Meek and Worthen. Type, *Nautilus spectabilis*, Meek and Worthen, Geol. Surv. Illinois, vol. ii. pl. xxv. (1866).

APSIDOCERATIDÆ, Hyatt, 1883.

- Tripleuroceras*, Hyatt. Type, *Orthoceras Archiaci*, Barrande, Syst. Sil. Boh. vol. ii. pl. ccli. (1868).
Apsidoceras, Hyatt. Type, *Gyroceras magnificum*, Billings, Rep. Prog. Geol. Surv. Canada, 1853-1856, p. 307 (1857).
Titanoceras, Hyatt. Type, *Nautilus ponderosus*, White, United States Geol. Surv., Final Rep., Nebraska, Hayden, pl. iii. (1872).
**Ephippioceras*, Hyatt. Type, *Nautilus ferratus*, Cox, in Owen, Geol. Kentucky, vol. iii. p. 574, pl. x. (1857).
Pteronutilus, Meek. Type, *Nautilus Sebachianus*, Geinitz, Dyas, Taf. xi. (1861).

TRIGONOCERATIDÆ, Hyatt, 1883.

- *Trigonoceras*, M'Coy. Type, *Orthocera paradoxica*, J. de C. Sowerby, Min. Conch. vol. v. pl. cccclvii. (1825).

Stroboceras, Hyatt. Type, *Gyroceras Hartii*, Dawson, *Acadian Geology*, 3rd ed. p. 311, fig. 125 (1878).

*Trematodiscus*¹, Meek and Worthen. Type, *Nautilus stygialis*, de Koninck, *Descrip. Anim. Foss. Terr. Carb. de Belgique*, pl. xlv. (1844).

Discitoceras, Hyatt [= **Discites*, M'Coy]. Type, *Discites costellatum*, M'Coy, *Synop. Carb. Foss. Ireland*, pl. ii. fig. 4 (1844).

* *Phacoceras*, Hyatt. Type, *Nautilus oxystomus*, Phillips, *Geol. Yorkshire*, pt. ii. pl. xxii. (1836).

Subclymenia, d'Orbigny. Type, *Goniatites evolutus*, Phillips, *Geol. Yorkshire*, pt. ii. pl. xx. ff. 65-68 (1836).

TRIBOLO CERATIDÆ, Hyatt, 1883.

Thoracoceras, Fischer de Waldheim. Type, *T. vestitum*, Fischer de W. *Bull. Soc. Imp. Nat. Moscou*, vol. xvii. p. 761, pl. xvii. (1844).

Triboloceras, Hyatt. Type, *Gyroceras serratum*, de Koninck, *Descrip. des Anim. Foss. du Terr. Carb. de la Belgique*, pl. xlviii. (1844).

Vestinautilus, Ryckholt. Type, *Nautilus Koninckii*, d'Orbigny, *Palæont. Univers.* vol. i. pl. xcv. (1847).

Koninckioceras, Hyatt. Type, *Nautilus ingens*, Martin, *Petrificata Derbiensia*, pl. xli. (1809). [= *Solenocheilus pentagonus*, J. Sowerby, sp., see *infra*, p. 176.]

AIPOCERATIDÆ, Hyatt, 1883.

Aploceras, d'Orbigny. Type, *Cyrtoceras Verneuilianum*, de Koninck, *Descrip. des Anim. Foss. du Terr. Carb. de la Belgique*, pl. xlv. (1844).

* *Aipoceras*, Hyatt. Type, *Gyroceras gibberosum*, de Koninck, *Faune du Calc. Carb. de la Belgique* (*Ann. Mus. Roy. d'Hist. Nat. de Belgique*, vol. v.) pt. ii. pl. xxxii. (1880).

Asymptoceras, Ryckholt. Type, *Nautilus cyclostomus*, Phillips, *Geol. Yorkshire*, pt. ii. pl. xviii. f. 3 (1836).

NAUTILIDÆ, Owen, 1836.

Sphyradoceras, Hyatt. Type, *Trochoceras Clio*, Hall, *Pal. New York*, vol. v. pt. ii. pl. lix. (1879).

Uranoceras, Hyatt. Type, *Cyrtoceras Uranus*, Barrande, *Syst. Sil. Boh.* vol. ii. pl. cxvi. (1866).

* *Barrandeoceras*, Hyatt. Type, *Nautilus natator*, Billings, *Canadian Naturalist and Geologist*, vol. iv. p. 466 (1859).

Pselioceras, Hyatt. Type, *Nautilus ophioneus*, Waagen, *Pal. Indica, Salt-Range Foss.* pl. v. (1879).

Nephriticeras, Hyatt. Type, *Nautilus bucinum*, Hall, *Pal. New York*, vol. v. pt. ii. pl. lx. (1879).

¹ Professor Hyatt proposed (*Genera Foss. Ceph.* p. 291, footnote) to change this name to *Trematoceras*. See *infra*, p. 105 (footnote).

Cenoceras, Hyatt. Type, *Nautilus*¹ *intermedius*, J. Sowerby, Min. Conch. vol. ii. pl. cxxv. (1816).

Cymatoceras, Hyatt. Type, *Nautilus pseudoelegans*, d'Orbigny, Paléont. Franç., Terr. Crét. vol. i. pl. viii. (1840).

**Nautilus*, Breyn. Type, *Nautilus pompilius*, Linné, Systema Naturæ, 10th ed. p. 708 (1758).

Professor Hyatt's system of classification (applicable alike to the Nautiloidea and the Ammonoidea) is best explained in his own words¹:—"It is a common mistake," he says, "to designate my classification as 'embryological.' It will be found by those who read these pages, that the whole life of the individual, and all its metamorphoses, have been deemed essential standards for the estimation of affinities. Even the degradational metamorphoses of old age are used as characteristics of value in the generic descriptions; it is properly speaking an ontological classification."

It will be seen in the above Table that Professor Hyatt has added many new genera to those already established, and that he has distributed the whole in a series of Families (all new, except *Nautilidæ*), which, in conformity with his views, blends the straight with the curved forms².

It will also be observed that the family *Nautilidæ* contains eight genera, including *Nautilus*. This genus, according to Hyatt, dates from the Jurassic period, the smooth forms of the Alpine Trias, such as *Nautilus Carolinus*, Mojs.³, *N. Tintoretti*, Mojs.⁴, being referred by Hyatt to his genus *Cenoceras*⁵, which has, however, for its type the well-known English Jurassic species, *N. intermedius*, J. Sowerby⁶.

The following genera and subgenera of the *Nautilidæ* are contained in the present volume⁷:—

TROCHOLITES, Conrad, 1838. (*Infrà*, p. 43.)

GYROCERAS, de Koninck, 1844. (*Infrà*, p. 53.)

¹ "Genesis of the Arietidæ" (Smithsonian Contributions to Knowledge), 1889, Preface, p. vii.

² See Part I. of the present Catalogue, Introduction, pp. v-vii.

³ Die Cephalopoden der Mediterranen Triasprovinz (Abhandl. d. k.-k. geol. Reichsanst. Band x.), 1882, p. 287.

⁴ *Ibid.* p. 283.

⁵ Proceed. Boston Soc. Nat. Hist. 1883, vol. xxii. p. 300.

⁶ *Infrà*, p. 192.

⁷ It will be observed that this Table differs slightly from the one published in Part I. (p. xxiii), which it is intended to supersede.

- Subgenus *AIPOCERAS*, Hyatt, 1883. (*Infrà*, p. 68.)
 Subgenus *TRIGONOCERAS*, M'Coy, 1844. (*Infrà*, p. 70.)
HERCOCERAS, Barrande, 1865. (*Infrà*, p. 74.)
BARRANDEOCERAS, Hyatt, 1883. (*Infrà*, p. 77.)
DISCITES, M'Coy, 1844. (*Infrà*, p. 86.)
 Subgenus *PHACOCERAS*, Hyatt, 1883. (*Infrà*, p. 98.)
EPHIPPIOCERAS, Hyatt, 1883. (*Infrà*, p. 100.)
CÆLONAUTILUS, Foord, Nov. 1889. (*Infrà*, p. 105.)
PLEURONAUTILUS, Mojsisovics, 1882. (*Infrà*, p. 134.)
TEMNOCHEILUS, M'Coy, 1844, emend. Meek, 1876. (*Infrà*, p. 142.)
 Subgenus *CENTROCERAS*, Hyatt, 1883. (*Infrà*, p. 163.)
SOLENOCHEILUS, Meek and Worthen, 1870, emend. Hyatt, 1883.
 (*Infrà*, p. 165.)
NAUTILUS, Breyer, 1732. (*Infrà*, p. 179.)
 Subgenus *HERCOGLOSSA*, Conrad, 1866, emend. Meek, 1876.
 (*Infrà*, p. 180.)
 Subgenus *CLYDONAUTILUS*, Mojsisovics, 1882. (*Infrà*, p. 182.)
ATURIA, Bronn, 1838. (*Infrà*, p. 335.)

The family *Nautilidæ*, as represented in the British Museum Collection (which is remarkably rich in representative forms), runs numerically very close to that of the *Orthoceratidæ*; both of them having, roughly speaking, about 180 species assigned to them. A series of Nautilus-like forms ranges from the Silurian (*Barrandeoceras*) through all the remaining geological periods, and leaves a representative (*Nautilus*) in the present seas. Modifications of the Nautilus type are, as might be expected in such a vast period of time, not unfrequent, and they have given rise to the creation of several well-marked groups or genera. The latter are, as a rule, based upon the external form of the shell. Thus, in *Barrandeoceras* the whorls are few, flattened, and very slightly embracing; in *Gyroceras* they are numerous, elliptical or subtriangular in section, and very loosely coiled; in *Discites* they are numerous, compressed, and more or less sulcated on the periphery. In some genera, such as *Ephippioceras* in the Carboniferous, and *Aturia* in the Miocene, the sutures afford the chief differential characters.

Another feature strikingly manifest in the Palæozoic Nautilidæ is their numerous and very slightly embracing whorls, and consequently wide umbilicus, with a large central perforation. These characters are met with in the earliest representatives of the groups under discussion, viz. the Silurian species *Barrandeoceras Bohemicus*, *B. Sternbergi*, &c., and they reach their maximum development in the Carboniferous genus *Discites*, some species of which are remark-

able for the great width of the umbilicus and the large size of the central perforation, as compared with the diameter of the shell¹.

Many of the Triassic species of *Temnocheilus* and *Pleuromutilus* still retain a large umbilicus, exposing the whole of the volutions; but the central perforation in them has become much reduced in size, though conspicuous in *Pleuromutilus Mosis*, Mojs.² Other Triassic forms, such as *Nautilus brembanus*, Mojs.³, *N. noricus*, Mojs.⁴, *N. galeatus*, Mojs.⁵, *N. triadicus*, Mojs.⁶, *N. (Hercoglossa) Sauperi*, Fr. v. Hauer⁷, &c., have the umbilicus closed, or nearly so, as in many of the Jurassic, Cretaceous, and Tertiary forms, and one of the living species (*N. pompilius*). In all of these the whorls are deeply embracing.

Some species resemble others chronologically remote from them; thus—*Nautilus hexagonus*, J. de C. Sowerby⁸ (= *N. giganteus*, d'Orb.), of the Jurassic, resembles in its sulcated periphery the Carboniferous genus *Discites*, and similarly *Nautilus triangularis*, Montfort⁹, in respect of its acute periphery recalls *Nautilus* [*Phacoceras*] *oxyostomus*, Phillips¹⁰. Among such morphological equivalents Professor Hyatt¹¹ notes "the extraordinary likeness of *Clydo-*

¹ See Waagen, Mem. Geol. Surv. India—Palæont. Indica—Ser. xiii. Salt-Range Fossils, 1879, vol. i. pt. i. p. 58, pl. v. ff. 2a, 2b, *Nautilus ophioncus*, Waagen, in which the central space is 1½ inches in diameter, the greatest diameter of the shell being only about 6 inches! Another species with a very wide central space is *Nautilus Meyerianus*, de Koninck (Calc. Carb. pt. i. 1878, pl. xxix. ff. 1, 2, 3). In this the central perforation measures 1 inch 1 line; while the greatest diameter of the shell is 4 inches 2 lines.

² See *infra*, p. 135, fig. 22.

³ Die Ceph. der Mediterr. Triasprov. 1882, p. 283, Taf. xc. figs. 4a, 4b.

⁴ Das Gebirge um Hallstatt (Abhandl. der k.-k. geol. Reichsanst. Band vi.), 1873, p. 25, Taf. xi. figs. 1, a-c, 2.

⁵ *Ibid.* p. 26, Taf. xii. figs. 1a, b, Taf. xiii. figs. 1a, 1b, 3.

⁶ *Ibid.* p. 27, Taf. xiv. figs. 1, 2 a-d, 3a, b, 4.

⁷ Haidinger's Naturwiss. Abhandl. 1846, Band i. p. 26, Taf. i. figs. 1-4.

⁸ Min. Conch. 1826, vol. vi. p. 55, pl. dxxix. fig. 2.

⁹ Pal. Franç., Terr. Crét. 1840, vol. i. p. 79, pl. xii.

¹⁰ Geol. Yorkshire, 1836, pt. ii. p. 233.

¹¹ "Morphological equivalence" is a phrase used by Prof. Hyatt, and he thus explains it:—"In the different genetic series of a type derived from one ancestral stock there is a perpetual recurrence of similar forms in similar succession, which are usually called representative and often falsely classified together, though they really belong to divergent genetic series."—"Genesis of the Arietidae" (Smithsonian Contributions to Knowledge), 1889, Preface, p. viii.

nautilus to the higher forms of the *Goniatitinae*, due to its divided ventral lobe; of *Centroceras* to *Agoniatites*, and of *Subclymenia* to *Agoniatites*, and also the better known example of the *Clymeninae* of the Devonian and the *Aturia* group of the Tertiary"; but, as further remarked by Hyatt, these parallel series occur in such zoological and geological relations as to render any sequence or descent of one from the other improbable. He supposes rather that they originated "independently of the direct influence of inheritance" ¹.

It might perhaps have been supposed that a genus so rich in species as *Nautilus* would have supplied many subdivisions or groups of species; but after carefully considering the matter, I have come to the conclusion that such groups are in the present case unnecessary, first, because the relationship in which the species stand to each other is fully set forth in the remarks appended to the descriptions of the species, and, secondly, because such groups are apt to become very artificial, owing to the necessity for frequent change in the selection of the characters upon which they rest. It is true that there are often met with in the genus *Nautilus* assemblages of species having many characters in common, which are, however, too variable to found genera upon. Thus, in the Jurassic, a group of species might be constituted having *Nautilus striatus*, J. Sow., as its typical member, and including *N. intermedius*, J. Sowerby, *N. simillimus*, Foord and G. C. Crick, *N. astacoides*, Young and Bird, and perhaps *N. ornatus*, Foord and G. C. Crick ². The characters uniting these species are, general conformity in external shape and close agreement in ornamentation.

In attempting to form groups of smooth-shelled species, we must shift our ground from ornamentation to similarity of shape. Thus, *Nautilus lineatus*, J. Sowerby, might be united with *N. pseudolineatus*, Foord and G. C. Crick, *N. polygonalis*, J. de C. Sowerby, and *N. glaber*, Foord and G. C. Crick, to form another group. The relationship of these species is pointed out in the description of *N. lineatus* (see *infra*, p. 213). They are all characterized by

¹ "Genesis of the Arietidaë" (Smithsonian Contributions to Knowledge), 1889, pp. 25-26. See also remarks on the genus *Aturia* at p. 341 of this volume.

² This group is equal at least in part to Hyatt's genus *Cenoceras*; type *N. intermedius*, J. Sow. (See Proceed. Boston Soc. Nat. Hist. vol. xxii. 1883 p. 300.)

laterally compressed whorls and a more or less truncated periphery, and two of them (*N. polygonalis* and *N. glaber*) agree in having markedly sinuous sutures, differing in this point from the other two species, and making a very perceptible approach to *Hercoglossa*.

Similarly, *Nautilus subtruncatus*, Morris and Lycett, *N. clausus*, d'Orbigny, and *N. lineolatus*, Foord and G. C. Crick, are regarded as allied species¹, because all of them have remarkably thick, subquadrate whorls, similar sutures, and a smooth test.

Passing on to the Cretaceous rocks, a group of species is met with, characterized by more or less coarse transverse costæ. *Nautilus elegans*, J. Sowerby, might be taken as the type of this group, which is made up of the following related species: *N. pseudoelegans*, d'Orbigny, *N. elegantoides*, d'Orbigny, and *N. Atlas*, Whiteaves². This group, which probably includes other species, is evidently equivalent to Hyatt's genus *Cymatoceras*, of which *N. pseudoelegans* was chosen for the type³.

In the Tertiary I have no groups of species to suggest; two species which differ from the rest in the sinuous characters of their sutures, being placed on that account in the subgenus *Hercoglossa*. These are *Nautilus (Hercoglossa) Cassinianus*, Foord and G. C. Crick, and *N. (H.) Ægyptiacus*, Foord.

An eminent palæontologist has taken occasion, in a recent work⁴, to utter a protest against the excessive multiplication of specific and varietal names. While admitting the great desirability of simplifying scientific nomenclature by reducing, as much as possible, the number of species, we must be very careful not to err in the opposite direction. It is only by taking cognizance of the most minute variations of individuals that it becomes possible to trace out the development of a group of fossils in geological time. It should be recollected, moreover, that the palæontological species rests upon a very different basis from that of the zoological one. The former, owing to the entire destruction of the soft parts of the animal,

¹ See *infra*, pp. 222-228.

² See Foord and G. C. Crick, *Geol. Mag.* dec. iii. vol. vii. 1890, p. 542.

³ *Proceed. Boston Soc. Nat. Hist.* vol. xxii. 1883, p. 301.

⁴ A. Gaudry, 'Les Enchaînements du monde animal dans les temps géologiques.' *Fossiles Secondaires.* 1890.

must, of necessity, be constructed upon characters which would be deemed in most cases insufficient for the establishment of the latter.

Until intermediate fossil forms are forthcoming in much greater numbers than heretofore, to bridge over the gaps in the palæontological series, it is to be feared that very little reduction can be made in the number of species that will have to be described.

In connection with this subject attention may be drawn to the remarks made by the late Dr. Neumayr¹ on the enormous development of marine life in the Jurassic epoch. We may consider it as proved, he says, that the diversity of marine life during the Jura epoch was about as great as it is at the present time. Now the Jura Formation contains more than thirty successive zones, each with a characteristic fauna; and even if each of these zones has a considerable number of species in common with the preceding, and with the following zone, the sum of all the forms that lived during the whole course of the Jurassic period must have surpassed that of the present marine fauna by a large amount, perhaps from ten to fifteen times in excess of the latter. It can hardly have comprised less than from 500,000 to 750,000 species. Of this overwhelming multitude only an insignificant proportion is known. Out of all the Jurassic deposits there may be about 10,000 marine animals described, a number which must certainly be considered very small.

In the Table of the Nautiloidea contained in Part I. of the present Catalogue, p. xxiii, I inserted the Family *Bactritidæ*. On reconsidering the question of the affinities of *Bactrites* (the sole representative of the family), in the light of the investigations of Branco² and Hyatt³, I am now prepared to accept the systematic position assigned to it by those authors—that is, at the commencement of the Ammonoidea. *Bactrites* will therefore be dealt with in Part III. instead of in this volume.

¹ Die Stämme des Thierreiches. Wirbellose Thiere. Band i. 1889, pp. 21, 22.

² "Ueber die Anfangskammer von *Bactrites*," Zeitschr. der Deutsch. geol. Gesell. Band xxxvii. Heft i. 1885, p. 1.

³ "On Primitive Forms of Cephalopods," American Naturalist, Jan. 1887, p. 64. See also "Genesis of the Arietidæ" (Smithsonian Contributions to Knowledge, 1889, Introduction, pp. 1-3.

A.—Table of Distribution of Genera and Subgenera of NAUTILOIDEA described in Parts I. and II. of the present Catalogue,
with the number of Species¹ assigned to each.

FAMILIES and GENERA.	References to pages of Catalogue.				CAMBRIAN.	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	TRIASSIC.	JURASSIC.	CRETACEOUS.	TERTIARY.	Totals of species.
	Part I.	Addenda to Part I.	Supplement to Part I.	Part II.										
ORTHO CERATIDE	1	78	319	...	2	24	89	29	36	3	..	..	..	183
Orthoceras.....	1	...	336	...	1	15	1	..	..	..	..	..	..	17
ENDOCERATIDE	129	...	...	...	1	...	..	..	..	..	..	..	..	2
Endoceras	129	...	...	...	1	...	..	..	..	..	..	..	..	1
Piloceras	157	...	...	...	1	6	11	1	5	..	..	..	..	24
ACTINOCERATIDE	164	...	...	...	1	1	..	..	..	..	..	..	..	3
Actinoceras	164	...	322	...	..	1	8	..	..	..	..	..	..	1
? Gonioceras .....	...	...	...	...	..	..	1	..	..	..	..	..	..	2
Discosorus	194	...	...	...	..	..	3	..	..	..	..	..	..	3
Huronina.....	199	...	...	...	..	..	..	..	..	..	..	..	..	1
Sactoceras	207	...	...	...	..	..	1	..	..	..	..	..	..	1
GOMPHOCERATIDE	211	...	...	...	..	..	21	3	..	..	..	..	..	24
Gomphoceras	211	...	...	...	..	..	6	..	..	..	..	..	..	6
Tetrameroceras.....	235	...	...	...	..	..	1	..	..	..	..	..	..	1
Hexameroceras.....	242	...	...	...	..	..	..	..	..	..	..	..	..	1
ASCO CERATIDE	246	...	...	...	..	..	..	..	..	..	..	..	..	4
Asoceras	246	...	334	...	..	..	4	..	..	..	..	..	..	4
Glossoceras	253	...	...	...	..	..	1	..	..	..	..	..	..	1

The accompanying Tables have been prepared, viz. Table A, pp. xviii, xix, showing the distribution in time of the genera and subgenera of the Nautiloidea contained in the British Museum, with the number of species assigned to each, under their respective Formations; the large Table B indicating, approximately, the correlations of the Secondary and Tertiary rocks of England with those of part of the Continent of Europe. The purpose of this Table is to show as many as possible of the stratigraphical divisions referred to under the descriptions of the species. The principal works consulted in the compilation of this table are as follows:—for the English rocks, H. B. Woodward's 'Geology of England and Wales' (1887); for those of France, de Lapparent's 'Traité de Géologie' (1885); for those of Belgium, Mourlon's 'Géologie de la Belgique' (1880–1881), and Vanden Broeck's 'Esquisse Géologique et Paléontologique des Dépôts Pliocènes des Environs d'Anvers' (1876–1878); for those of Germany and Austria-Hungary, Credner's 'Elemente der Geologie' (1887); for those of Switzerland and the Alps, Renevier's 'Tableau des Terrains Sédimentaires' (1874), and other works. I am particularly indebted to Mr. G. F. Harris, F.G.S., for valuable information regarding the correlation of the Tertiary rocks of England with those of Belgium and France, a subject to which he has devoted special attention.

Since the publication of Part I. my attention has been directed to some of the structural characters of the *Nautilidae*. Amongst these may be mentioned the discovery of very distinct marks of the shell-muscle upon casts of several Carboniferous and Jurassic species¹. The results of a study of these interesting features have been published from time to time by myself, in conjunction with Mr. G. C. Crick, of the Geological Department of the British Museum, in the 'Geological Magazine' and in the 'Annals and Magazine of Natural History.' These results are all embodied in the present volume, at the pages indicated in the footnote at the bottom of this page.

In a paper contributed to the 'Annals and Magazine of Natural History' (ser. 6, vol. v. 1890, p. 404) by Mr. Crick and myself, a

¹ See *infra*, pp. 106, 172, 214, 219, 225, 226 (figs. 15, 29, 42, 43, 46, 49, 50).

B.—APPROXIMATE CORRELATION OF THE SECONDARY AND TERTIARY ROCKS OF ENGLAND AND PART OF THE CONTINENT OF EUROPE.

		ENGLAND.		BELGIUM.		FRANCE.		GERMANY AND AUSTRIA-HUNGARY.		SWITZERLAND AND THE ALPS.											
TERTIARY OR CENOZOIC.	PLIOCENE.	Cromer Forest Bed Series.	Newer Pliocene.	Sables supérieurs d'Anvers à <i>Chrysolobos antiquus</i> , &c.	Sables à <i>Nassa</i> du Cotentin. Sables à <i>Mastodon Arvernensis</i> du Roussillon.	Couches ossifères de Saint-Prest (Eure-et-Loire), à <i>Elephas meridionalis</i> .	Schleswig-Holstein Schichten.	Dinotherien-sand von Eppelheim (Mayence Basin).	Paludine-Schichten, &c. Belvedere-Schotter ¹² . Congerion-Schichten.	Molasse ossifère du Loos et de la Chaussée-de-Fonds à <i>Dinotherium gigantum</i> . (Jura.)											
		Norwich Crag Series.																			
		Red Crag.																			
	MIOCENE.	Coralline Crag.	Older Pliocene.	Sables moyens d'Anvers à <i>Isocardia cor.</i> , &c. Sables inférieurs d'Anvers à <i>Pectunculus pilosus</i> , &c.	Couches à <i>Potamides Basteroti</i> . (Bassin du Rhône, Roussillon.)	Faluus 1 ^{re} de Saubrigues, Anjou, &c.	Mayence Basin. Hydrobien- (Littorinellen-) Schichten, &c.	Sarmatische-Stufe (Cerithien-Sandstein, brackische Tegel).	Molasse d'eau douce supérieure d'Enningen. Weltheim, &c.												
		Lenham Beds ¹ .																			
		Waiting.																			
	OLIGOCENE.	Hempested Beds.	Upper. Middle, or Brockenhurst Beds. Lower, Hordwell Beds, &c.	Étage supérieur ou marin. Sables blancs du Bolderberg, &c. Étage inférieur ou fluviomarin. Sables de Norrepen. Sables de Grammeringen.	Paris Basin. Calcaires de Beaucourt. Marnes d'Étampes. Grès de Fontainebleau, &c. Sables de Morigny. Calcaire de la Brie.	Auvergne, Languedoc. Marnes de Fontcaud. Calcaires à <i>Potamides Lamarcki</i> . Marnes de Ronsay. Arkose de la Lirouge. Marnes à <i>Cyrenes</i> de Montels.	Paris Basin. Calcaires de Beauchamp (= Sables moyens). Calcaire grossier. Sables de Cuis. Sables de Siney. Argile plastique de Paris et du Soissonais. Sables de Bracheux, La Fère, &c.	North Germany. Obere norddeutsche Braunkohlen. Mergel von Osnabrück, &c. Septarien. Stettiner und Söllinger Sand (Rupelian). Braunkohlen. Thone von Egel. Unterste norddeutsche Braunkohlenbildung, &c.	Molasse marine d'Undervillers, Chaux-de-Fonds, &c. (Jura.)												
		Bembridge Beds.																			
		Osbome Beds.																			
	Eocene.	Hendon Beds.	Middle. Lower. Barton Clay and Sands. Bracklesham Beds (Upper and Middle Bagshots). Lower Bagshot and London Sands. London Clay and Bognor Beds. Oldhaven and Blackheath Beds. Woolwich and Reading Beds. Thanet Beds.	Sables Aschien. Couches Wemmelien. Sables Lachenien. Sables Bruxellien. Sables Panuelien. Ypresien supérieur. Ypresien inférieur. Landenien supérieur. Landenien inférieur. Couches Heersien. Calcaire de Mons. Tufeau de Ciply ⁷ .	Paris Basin & Normandy. Calcaire pisolitique à <i>Nautilus Danicus</i> , &c. Calcaire à <i>Baculites</i> du Cotentin. Craie de Meudon, &c. Craie à <i>Micraster cor-anguinum</i> . Craie à <i>Micraster cor-testudinarius</i> , &c.	Maine, Touraine, &c. Craie de Chartres, &c.	Saxony. Obere Quader mit <i>Pecten quadriscutatus</i> . Obere Quadermergel. Obere Pläner mit <i>Spondylus spinosus</i> , &c. Copitzer Grünsandstein. Mittlerer Pläner oder Mittlerer Quader, mit <i>Inoceramus labiatus</i> , &c.	North-west Germany. Flammenmergel. Schichten mit <i>Ammonites Miliatensis</i> . Speeton Clay mit <i>Belemnites brucei</i> , &c.	North-eastern Alps. Gosauschichten. Unterer Pläner und Serpula-Sand mit <i>Serpula plexus</i> , &c. Unterer Quader und Grünsandstein; Pflanzen-führ.	Bavaria, &c. Flysch u. Haring Schichten. Kreisenberg Schichten. Burberg Schichten.	Jura. Molasse d'eau douce inférieure à <i>Holzia Ramondi</i> . Marnes à poissons de Froidefontaine près Belfort. Siderolite à Palaeotherium, &c.	Plains. Molasse à Lignites de Roehette, &c. Molasse rouge du pied du Jura. Sub-Alpine Zone. Flysch à Furcides.									
Waiting.																					
Waiting.																					
CRETACEOUS.	Upper Cretaceous.	with <i>Micraster cor-anguinum</i> . with <i>Micraster cor-testudinarius</i> .	Craie blanche du Hainaut à <i>Belemnites mucronata</i> .	Smeectite de Herre à <i>Belemnites quadrata</i> .	Craie à <i>Micraster breviporus</i> , &c. Craie marneuse à <i>Inoceramus labiatus</i> .	Calcaire à <i>Ammonites Requien</i> . Tufeau à <i>Ammonites papalis</i> .	Craie à <i>Belemnites plena</i> . Couches fossilifères de Rouen. Craie glauconieuse à <i>Pecten asper</i> .	Marnes à Ostracées, &c. Sables et grès du Maine.	North-west Germany. Flammenmergel. Schichten mit <i>Ammonites Miliatensis</i> . Speeton Clay mit <i>Belemnites brucei</i> , &c.	Bavarian Alps. Grünsand mit <i>Turritella Bergi</i> (Turritellensand).	Gault supérieur sableux à <i>Ammonites inflatus</i> . Gault inférieur sableux à <i>Ammonites Miliatensis</i> .	Gault supérieur à <i>Ammonites inflatus</i> . Gault inférieur à <i>Ammonites maculatus</i> .									
		Chalk.																			
		Chalk Marl.																			
	Lower Cretaceous.	Chalk Marl. Chloritic Marl (and Red Chalk). [Cambridge Greensand ²].	Tourtia de Mons à <i>Pecten asper</i> . Tourtia de Tournai. (Syst. Hervey.) Meule de Braqueguais. (Syst. Dumont.)	Sables et argile d'Hauterive ¹⁵ . Sables d'Aix-la-Chapelle ¹⁶ (Syst. Aachenien de Dumont).	Marnes et calcaires à Spatangus, &c. Marnes noires.	Sables blancs à fougères, &c. du Bray.	Sables à <i>Ammonites Miliatensis</i> . Argile à plicatules de Grandpré. Couches rouges de Wassy, &c.	Marnes à Pterocères. Calcaire de Brusdale. Calcaire du mont des Boucards. Calcaire d'Houlfort, &c. Argiles supérieures du Wast, &c. Argiles ferrugineuses de Belle. Zone à <i>Waldheim laganales</i> . Zone à <i>Rhynchonella elegantula</i> . Oolithe de Marquise. Marnes à <i>Clypeus</i> et <i>Ostrea Sowerbyi</i> .	Sables lignitiformes.	North-west Germany. Parbeckschichten. Eimbeckhauser Plattenkalk. Schichten mit <i>Oleostephanus gigas</i> . Nerensschichten. Korallen-Oolith. Hersemmer Schichten. Kelloway a, Ornamentone. Eisenkalk des Cornbrash mit <i>Avicula echinata</i> , &c. Schichten der <i>Ostrea Knorri</i> , mit <i>Ammonites ferrugineus</i> , &c. Schichten des <i>Ammonites Parkinsoni</i> . Cornatenschichten, mit <i>Ammonites Humphriesianus</i> , &c. Schichten des <i>Inoceramus polypleus</i> , mit <i>Ammonites Marchisoni</i> . Schichten des <i>Ammonites opalinus</i> .	Carpathians, &c. Stramberger Schichten. Diphyskalk. Acanthus-Schichten. Transversarius-Schichten. Makrocephalus-Schichten. Poissonomyen-Schichten der süd-Alpen.	Western Jura. Marnes à <i>Planorbis Loryi</i> . Calcaire Portlandien. Marnes à <i>Ecogyra virgula</i> . Astarien compacte, &c. Oolite corallienne à <i>Nerinees</i> et <i>Diercks</i> . Marnes Oxfordiennes à <i>Ammonites Lumberti</i> . Callovien ferrugineux à <i>Ammonites onega</i> . Cornbrash à <i>Waldheimia laganales</i> . Calcaire roux sableux et Grando colite du Jura bernois, &c. Marnes vésuliennes à <i>Ostrea acuminata</i> . Zone à <i>Ammonites Humphriesianus</i> du Jura bernois.	Western Alps. Calcaire blanc thionique à <i>Terebratulites junior</i> . Calcaire à <i>Aptychus</i> . Corallien blanc colitique. Schistes à <i>Ammonites Lumberti</i> . Schistes liasiques à <i>Ammonites serpinatus</i> . Schistes à <i>Ammonites margaritatus</i> . Calcaire à <i>Ammonites variolatus</i> . Calcaire liasique à <i>Gryphaea arcuata</i> .								
		Upper Greensand.																			
		Gault.																			
	Lower Cretaceous.	Walden Series. Weald Clay. Hastings Beds.	Sables et argile d'Hauterive ¹⁵ . Sables d'Aix-la-Chapelle ¹⁶ (Syst. Aachenien de Dumont).	Marnes et calcaires à Spatangus, &c. Marnes noires.	Sables blancs à fougères, &c. du Bray.	Sables à <i>Ammonites Miliatensis</i> . Argile à plicatules de Grandpré. Couches rouges de Wassy, &c.	Marnes à Pterocères. Calcaire de Brusdale. Calcaire du mont des Boucards. Calcaire d'Houlfort, &c. Argiles supérieures du Wast, &c. Argiles ferrugineuses de Belle. Zone à <i>Waldheim laganales</i> . Zone à <i>Rhynchonella elegantula</i> . Oolithe de Marquise. Marnes à <i>Clypeus</i> et <i>Ostrea Sowerbyi</i> .	Sables lignitiformes.	North-west Germany. Parbeckschichten. Eimbeckhauser Plattenkalk. Schichten mit <i>Oleostephanus gigas</i> . Nerensschichten. Korallen-Oolith. Hersemmer Schichten. Kelloway a, Ornamentone. Eisenkalk des Cornbrash mit <i>Avicula echinata</i> , &c. Schichten der <i>Ostrea Knorri</i> , mit <i>Ammonites ferrugineus</i> , &c. Schichten des <i>Ammonites Parkinsoni</i> . Cornatenschichten, mit <i>Ammonites Humphriesianus</i> , &c. Schichten des <i>Inoceramus polypleus</i> , mit <i>Ammonites Marchisoni</i> . Schichten des <i>Ammonites opalinus</i> .	Carpathians, &c. Stramberger Schichten. Diphyskalk. Acanthus-Schichten. Transversarius-Schichten. Makrocephalus-Schichten. Poissonomyen-Schichten der süd-Alpen.	Western Jura. Marnes à <i>Planorbis Loryi</i> . Calcaire Portlandien. Marnes à <i>Ecogyra virgula</i> . Astarien compacte, &c. Oolite corallienne à <i>Nerinees</i> et <i>Diercks</i> . Marnes Oxfordiennes à <i>Ammonites Lumberti</i> . Callovien ferrugineux à <i>Ammonites onega</i> . Cornbrash à <i>Waldheimia laganales</i> . Calcaire roux sableux et Grando colite du Jura bernois, &c. Marnes vésuliennes à <i>Ostrea acuminata</i> . Zone à <i>Ammonites Humphriesianus</i> du Jura bernois.	Western Alps. Calcaire blanc thionique à <i>Terebratulites junior</i> . Calcaire à <i>Aptychus</i> . Corallien blanc colitique. Schistes à <i>Ammonites Lumberti</i> . Schistes liasiques à <i>Ammonites serpinatus</i> . Schistes à <i>Ammonites margaritatus</i> . Calcaire à <i>Ammonites variolatus</i> . Calcaire liasique à <i>Gryphaea arcuata</i> .									
		Upper. Portland Stone. Portland Beds. Kimmeridge Clay.											Zone of <i>Ammonites communis</i> , <i>A. serpinatus</i> , &c. Zone of <i>Ammonites perarmatus</i> .	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.
		Corallian Beds.																			
	Oxford Clay.																				
Oolite.	Kelloway Rock.	Zone à <i>Ammonites Marchisoni</i> ; Calcaire de Longwy.	Marnes de Grandcourt. Grès de Virton, Marnes d'Arlon. Grès de Luxembourg. Marnes de Jamoigne. Marnes d'Helmingen. Grès de Martinsart.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.										
	Corbrash.																				
	Forest Marble and Bradford Clay.																				
Lower Oolite Ser.	Great Oolite. Stonesfield Slate. Fuller's Earth. Inferior Oolite. Midford Sands.	Zone à <i>Ammonites communis</i> , <i>A. serpinatus</i> , &c. Zone of <i>Ammonites spinatus</i> , <i>A. margaritatus</i> , &c. Zone of <i>Ammonites oxyotus</i> , <i>A. Bucklandi</i> , &c.	Marnes de Grandcourt. Grès de Virton, Marnes d'Arlon. Grès de Luxembourg. Marnes de Jamoigne. Marnes d'Helmingen. Grès de Martinsart.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.										
	Great Oolite.																				
	Stonesfield Slate.																				
Lias.	Zone of <i>Ammonites communis</i> , <i>A. serpinatus</i> , &c. Zone of <i>Ammonites spinatus</i> , <i>A. margaritatus</i> , &c. Zone of <i>Ammonites oxyotus</i> , <i>A. Bucklandi</i> , &c.	Marnes de Grandcourt. Grès de Virton, Marnes d'Arlon. Grès de Luxembourg. Marnes de Jamoigne. Marnes d'Helmingen. Grès de Martinsart.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.										
	Zone of <i>Ammonites communis</i> , <i>A. serpinatus</i> , &c.											Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.		
	Zone of <i>Ammonites spinatus</i> , <i>A. margaritatus</i> , &c.																				
Zone of <i>Ammonites oxyotus</i> , <i>A. Bucklandi</i> , &c.																					
Triassic.	Rhätian or Penarth Beds. (Zone of <i>Avicula Cassinella</i> [contorta].) Keuper Beds (or New Red Marl). (Upper (Waterstones). Lower or Basement Beds.)	Rhétien ou Bone-bed. ? Marnes triasiques de la Semois (Syst. Keuprique de Dumont).	Marnes de Grandcourt. Grès de Virton, Marnes d'Arlon. Grès de Luxembourg. Marnes de Jamoigne. Marnes d'Helmingen. Grès de Martinsart.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.										
	Waiting.											Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.		
	Waiting.																				
Waiting.																					
Triassic.	Upper. Portland Stone. Portland Beds. Kimmeridge Clay.	Zone of <i>Ammonites communis</i> , <i>A. serpinatus</i> , &c. Zone of <i>Ammonites spinatus</i> , <i>A. margaritatus</i> , &c. Zone of <i>Ammonites oxyotus</i> , <i>A. Bucklandi</i> , &c.	Marnes de Grandcourt. Grès de Virton, Marnes d'Arlon. Grès de Luxembourg. Marnes de Jamoigne. Marnes d'Helmingen. Grès de Martinsart.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.										
	Corallian Beds.											Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.		
	Oxford Clay.																				
Kelloway Rock.																					
Oolite.	Kelloway Rock.	Zone à <i>Ammonites Marchisoni</i> ; Calcaire de Longwy.	Marnes de Grandcourt. Grès de Virton, Marnes d'Arlon. Grès de Luxembourg. Marnes de Jamoigne. Marnes d'Helmingen. Grès de Martinsart.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.										
	Corbrash.											Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.		
	Forest Marble and Bradford Clay.																				
Great Oolite.																					
Lower Oolite Ser.	Great Oolite. Stonesfield Slate. Fuller's Earth. Inferior Oolite. Midford Sands.	Zone à <i>Ammonites communis</i> , <i>A. serpinatus</i> , &c. Zone of <i>Ammonites spinatus</i> , <i>A. margaritatus</i> , &c. Zone of <i>Ammonites oxyotus</i> , <i>A. Bucklandi</i> , &c.	Marnes de Grandcourt. Grès de Virton, Marnes d'Arlon. Grès de Luxembourg. Marnes de Jamoigne. Marnes d'Helmingen. Grès de Martinsart.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.										
	Great Oolite.											Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.		
	Stonesfield Slate.																				
Fuller's Earth.																					
Lias.	Zone of <i>Ammonites communis</i> , <i>A. serpinatus</i> , &c. Zone of <i>Ammonites spinatus</i> , <i>A. margaritatus</i> , &c. Zone of <i>Ammonites oxyotus</i> , <i>A. Bucklandi</i> , &c.	Marnes de Grandcourt. Grès de Virton, Marnes d'Arlon. Grès de Luxembourg. Marnes de Jamoigne. Marnes d'Helmingen. Grès de Martinsart.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.										
	Zone of <i>Ammonites communis</i> , <i>A. serpinatus</i> , &c.											Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.		
	Zone of <i>Ammonites spinatus</i> , <i>A. margaritatus</i> , &c.																				
Zone of <i>Ammonites oxyotus</i> , <i>A. Bucklandi</i> , &c.																					
Triassic.	Rhätian or Penarth Beds. (Zone of <i>Avicula Cassinella</i> [contorta].) Keuper Beds (or New Red Marl). (Upper (Waterstones). Lower or Basement Beds.)	Rhétien ou Bone-bed. ? Marnes triasiques de la Semois (Syst. Keuprique de Dumont).	Marnes de Grandcourt. Grès de Virton, Marnes d'Arlon. Grès de Luxembourg. Marnes de Jamoigne. Marnes d'Helmingen. Grès de Martinsart.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.										
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Triassic.	Upper. Portland Stone. Portland Beds. Kimmeridge Clay.	Zone à <i>Ammonites Marchisoni</i> ; Calcaire de Longwy.	Marnes de Grandcourt. Grès de Virton, Marnes d'Arlon. Grès de Luxembourg. Marnes de Jamoigne. Marnes d'Helmingen. Grès de Martinsart.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.										
	Corallian Beds.											Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.		
	Oxford Clay.																				
Kelloway Rock.																					
Oolite.	Kelloway Rock.	Zone à <i>Ammonites Marchisoni</i> ; Calcaire de Longwy.	Marnes de Grandcourt. Grès de Virton, Marnes d'Arlon. Grès de Luxembourg. Marnes de Jamoigne. Marnes d'Helmingen. Grès de Martinsart.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.										
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	Forest Marble and Bradford Clay.																				
Great Oolite.																					
Lower Oolite Ser.	Great Oolite. Stonesfield Slate. Fuller's Earth. Inferior Oolite. Midford Sands.	Zone à <i>Ammonites communis</i> , <i>A. serpinatus</i> , &c. Zone of <i>Ammonites spinatus</i> , <i>A. margaritatus</i> , &c. Zone of <i>Ammonites oxyotus</i> , <i>A. Bucklandi</i> , &c.	Marnes de Grandcourt. Grès de Virton, Marnes d'Arlon. Grès de Luxembourg. Marnes de Jamoigne. Marnes d'Helmingen. Grès de Martinsart.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.										
	Great Oolite.											Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.		
	Stonesfield Slate.																				
Fuller's Earth.																					
Lias.	Zone of <i>Ammonites communis</i> , <i>A. serpinatus</i> , &c. Zone of <i>Ammonites spinatus</i> , <i>A. margaritatus</i> , &c. Zone of <i>Ammonites oxyotus</i> , <i>A. Bucklandi</i> , &c.	Marnes de Grandcourt. Grès de Virton, Marnes d'Arlon. Grès de Luxembourg. Marnes de Jamoigne. Marnes d'Helmingen. Grès de Martinsart.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.										
	Zone of <i>Ammonites communis</i> , <i>A. serpinatus</i> , &c.											Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.		
	Zone of <i>Ammonites spinatus</i> , <i>A. margaritatus</i> , &c.																				
Zone of <i>Ammonites oxyotus</i> , <i>A. Bucklandi</i> , &c.																					
Triassic.	Rhätian or Penarth Beds. (Zone of <i>Avicula Cassinella</i> [contorta].) Keuper Beds (or New Red Marl). (Upper (Waterstones). Lower or Basement Beds.)	Rhétien ou Bone-bed. ? Marnes triasiques de la Semois (Syst. Keuprique de Dumont).	Marnes de Grandcourt. Grès de Virton, Marnes d'Arlon. Grès de Luxembourg. Marnes de Jamoigne. Marnes d'Helmingen. Grès de Martinsart.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.										
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Triassic.	Upper. Portland Stone. Portland Beds. Kimmeridge Clay.	Zone à <i>Ammonites Marchisoni</i> ; Calcaire de Longwy.	Marnes de Grandcourt. Grès de Virton, Marnes d'Arlon. Grès de Luxembourg. Marnes de Jamoigne. Marnes d'Helmingen. Grès de Martinsart.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.										
	Corallian Beds.											Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.		
	Oxford Clay.																				
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Oolite.	Kelloway Rock.	Zone à <i>Ammonites Marchisoni</i> ; Calcaire de Longwy.	Marnes de Grandcourt. Grès de Virton, Marnes d'Arlon. Grès de Luxembourg. Marnes de Jamoigne. Marnes d'Helmingen. Grès de Martinsart.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.										
	Corbrash.											Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.	Waiting.		
	Forest Marble and Bradford Clay.																				
Great Oolite.																					
Lower Oolite Ser.	Great Oolite. Stonesfield Slate. Fuller's Earth. Inferior Oolite. Midford Sands.	Zone à <i>Ammonites communis</i> , <i>A. serpinatus</i> , &c. Zone of <i>Ammonites spinatus</i> , <i>A. margaritatus</i> , &c. Zone of <i>Ammonites oxyotus</i> , <i>A. Bucklandi</i> , &c.	Marnes de Grandcourt. Grès de Virton, Marnes d'Arlon. Grès de Luxembourg. Marnes de Jamoigne. Marnes d'Helmingen. Grès de Martinsart.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.	Calcaire à gryphées arquées. Calcaire à gryphées arquées.										
	Great Oolite.											Waiting.	Waiting.	Waiting.							



new species of *Nautilus* (*N. Libanoticus*) from the Upper Cretaceous of Lebanon was described and figured. This species is particularly interesting, from the fact that many of the specimens representing it in the Collection have one or other of the beaks or mandibles of the animal attached to them on the ventral (convex) side of the body-chamber. Two of the beaks are figured separately at p. 305 of this volume; but I have added (p. 371) a figure of an upper mandible attached to a specimen of *Nautilus Libanoticus*, in the position above described. This is, I believe, the first figure of the kind published.

I may also mention that an enlarged figure (fig. 73), showing the different layers composing the siphuncle of *Aturia*, will be found at p. 338, to illustrate the description of those layers and their relationship with similar layers found in the siphuncle of *Nautilus pompilius*.

The Supplement to the present volume (pp. 378-399) contains descriptions of species recently added to the Collection, with some few inadvertently omitted; also notices of recent works on the Nautiloidea, particularly Dr. Lindström's valuable memoir on the *Ascoceratidæ* and *Lituitidæ* of the Silurian rocks of Gothland.

I may here state that all the illustrations of the present volume were drawn by myself on the wood, the outlines being first made with the aid of a camera so as to ensure accuracy of proportion in the figures.

It only remains for me now to express my great indebtedness to all those who have aided me in the performance of my present task. I have to tender my sincere thanks to Dr. Paul Fischer, of the Museum of Natural History, Paris, and also to the authorities of the Woodwardian Museum, Cambridge, and the Museum of Practical Geology, Jermyn Street, for the loan of valuable specimens from the Collections under their charge. To Professor K. A. von Zittel and his colleagues in the Palæontological Museum in Munich I am much indebted for the many facilities afforded me while studying there in 1889; and I am similarly beholden to M. Dollo, of the Royal Museum of Natural History in Brussels, whose good offices were extended to me while I was in the latter city in the same year.

To Dr. Henry Woodward I am again indebted for many valuable suggestions while supervising the work throughout its progress.

Mr. G. C. Crick has again done me the important service of looking over the proofs, and of giving me the benefit of his criticisms on many points, and Mr. B. B. Woodward has helped me in connection with the literature of the fossil Cephalopoda.

ARTHUR H. FOORD.

London,
February 12th, 1891.

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CORRIGENDA ET ADDENDA.

- Page 86, line 2 from top, add *Ellipsolites* (pars), J. Sowerby, Min. Conch. vol. i. 1813, p. 84.
- „ 142, line 12 from top, add *Kophinoceras* (pars), Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. 1883, p. 285.
- „ 147, line 14 from bottom (under *Nautilus latus*, de Koninck), add “*Not of Meek and Worthen.*”
- „ 244, line 12 from top, to British Localities add Seend, Wiltshire.
- „ „ line 15 from top, also p. 297, line 4 from top, p. 298, line 14 from bottom, and p. 301, line 4 from top, for Maestricht, Belgium, read Maestricht, Holland.
- „ 254, line 21 from top, add *Not* before “1853. *Nautilus pseudoelegans*, Sharpe,” &c.
- „ 270, line 4 from bottom, for *Nautilus elegans*, Sharpe, read *Nautilus pseudoelegans*, Sharpe.

CATALOGUE

OF

FOSSIL CEPHALOPODA.

Suborder *NAUTILOIDEA* (continued).

Family LITUITIDÆ ¹.

Genus **LITUITES**, Breyn.

(*Hortolus*, Montfort, 1808 ³; *Spirulites*, Parkinson, 1811 ⁴; *Orthoceratites*, Schlotheim, 1820 ⁵; *Lithuities*, Schlotheim, 1820 ⁶; *Orthoceratites*, Quenstedt, 1849 ⁷.)

Gen. Char. The shell is at first coiled in one plane, the whorls, which are generally four in number, being either contiguous or slightly separated; it is then extended in a long straight piece which gradually increases in diameter till the aperture is attained. The straight part is always bent inwards a little near its commencement. The aperture of the body-chamber is contracted, owing to

¹ Written *Lituidæ* by Noetling (Jahrb. der Königl. Preuss. geol. Landesanst. und Bergakad. f. d. Jahr 1883, p. 129).

² Dissert. Phys. de Polythalamiiis, 1732, pp. 12, 26.

³ Conchyl. Systém. tom. i. p. 283.

⁴ Organic Remains, vol. iii. p. 110.

⁵ Die Petrefactenkunde, p. 55 (*Orthoceratites undulatus*).

⁶ Ibid. p. 59.

⁷ Petrefactenkunde Deutschl., Band i. p. 44 (*Orthoceratites undulatus*).

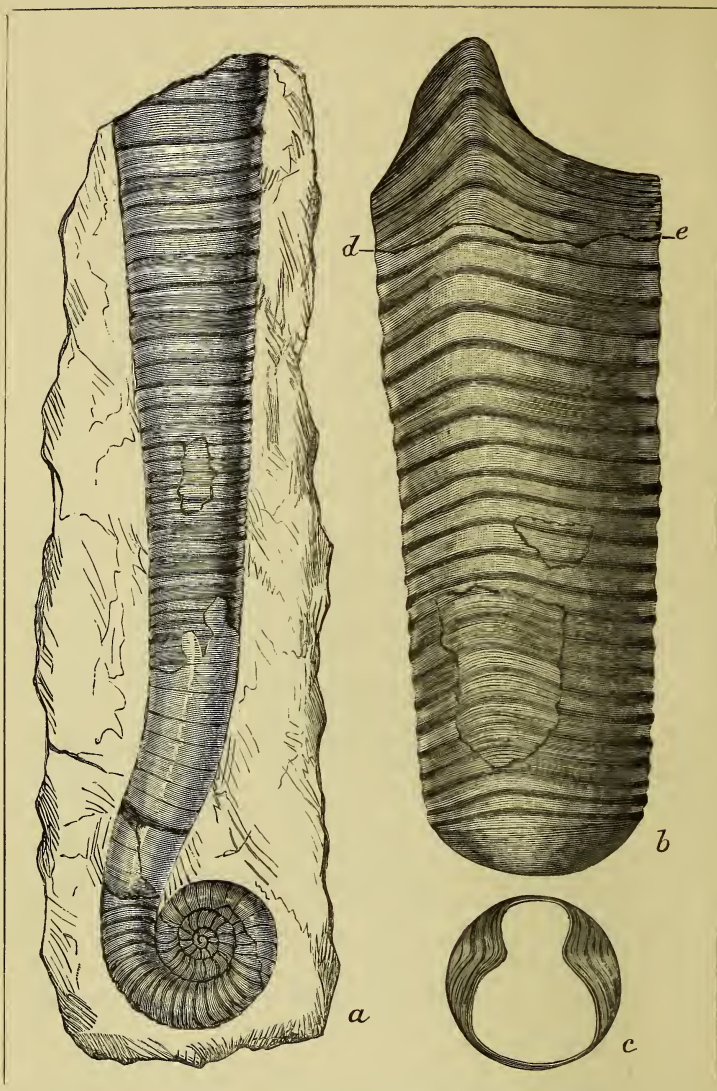


Fig. 1.—*Lituites lituus*, nat. size ; after Lossen.—*a*, coiled, and part of straight portion of shell ; *b*, body-chamber, with restored (?) aperture : the central portion of the shell is missing ; it is indicated in outline in Lossen's figure, but is omitted here for economy of space ; *c*, bilobate aperture seen from above (restored ?).

the development of two lobes¹. The septa are approximate, rather strongly concave; the necks short and directed backwards; the sutures are simple. The siphuncle is cylindrical, subcentral, nearest to the dorsal (inner) side. The shell consists of three layers—the inner, which is smooth and forms the septa; the middle, finely punctured; and the outer, marked with fine transverse striæ. Strong, numerous, and tolerably regular lines of growth in the form of flattish annulations are also present.

Remarks. Attempts have been made to separate this genus into two groups; the one embracing forms in which the whorls are in contact, the other those in which they are disconnected. Montfort established the genus *Hortolus* to include the latter forms, but it has not been generally adopted². Satisfactory evidence of the existence of species of *Lituities* with disconnected whorls appears to be wanting, for we find that the figures representing such forms have either been “restored” or else drawn from imperfect specimens, in which a portion of the spire or of the test was absent³.

Quenstedt⁴ divided *Lituities* into two groups: those in which the whorls only touch each other at their commencement, but afterwards become evolute, he called *Lituities perfecti*; while those in which all the whorls are contiguous except the last he called *Lituities imperfecti*. Lossen⁵ adopting similar names, but in a different sense, distinguished species having the spire slightly developed and the last whorl greatly elongated, under the name *Lituities perfectiones*; while those in which the spire was well developed and the last whorl short he designated *Lituities imperfectiores*.

¹ I give this on Lossen's authority (Zeitschr. der Deutsch. geol. Gesell. 1860, Band xii. p. 15, Taf. i. ff. 1 a, 1 c); but the lobate portion of the aperture appears to have been added in his figure, in accordance with his views of its form, based upon the lines of growth. See fig. 1, d, e, where the specimen appears to have been broken, the lobed part, above the line of fracture, being restored. Noetling (Zeitschr. der Deutsch. geol. Gesell. 1882, Band xxxiv. Heft i. p. 156, Taf. xi.) makes out that the aperture has four lobes, and he gives restored figures of these, viewed laterally and from above. His figure of the specimen upon which his observations were based is, however, imperfect, and the aperture partly concealed by the matrix; moreover, the lines of growth do not indicate more than two lobes, which is in fact the number figured by Lossen (Zeitschr. der Deutsch. geol. Gesell. Band xii. p. 15, Taf. i. ff. 1 a, 1 c).

² See, however, McCoy (British Pal. Foss. fasc. ii. 1852, p. 324), who adopts the name *Hortolus* for *Lituities giganteus* and *L. ibex* of J. de C. Sowerby.

³ See Lossen, Zeitschr. der Deutsch. geol. Gesell., Band xii. 1860, p. 16, Taf. i. f. 1 a; Angelin and Lindström, Fragmenta Silurica, tab. xi.; Breyn, Dissert. phys. de Polythalam. tab. ii. f. 11; &c.

⁴ ‘De Notis Nautilæarum Primariis,’ 1836.

⁵ Zeitschrift der Deutsch. geol. Gesell., Band xii. 1860, p. 15.

F. Noetling, in an elaborate paper, "Ueber *Lituites lituus*, Montfort,"¹ discusses the subject of the classification and development of *Lituites* in an exhaustive manner. He concludes his memoir by suggesting that the shell must at successive epochs have passed through the following phases:—(1) The *Nautilus*-Stage, in which the shell resembled a very evolute *Nautilus*-shell; the aperture two-lobed (judging by the lines of growth), with deep, narrow ventral sinus, broad, not very high lappets at the side, and shallow dorsal sinus; (2) the *Imperfecti*-Stage, which was entered upon immediately after the shell had ceased to be coiled, and included only a short bent portion; (3) the *Perfecti*-Stage, which included the continuation of the shell in a straight direction up to the aperture. These points will be made clearer by referring to the illustration on p. 2 (fig. 1), which shows that the *Imperfecti*-Stage is, after all, but very slightly marked off from the *Perfecti*-Stage. Noetling finds in the development of *Lituites lituus* indications of the descent of the genus *Lituites* from *Nautilus*-like ancestors, though nothing is yet known of the parent form.

In a later publication² he institutes the family *Lituidæ* for the two genera *Lituites* and *Ancistroceras*, the latter of which supersedes *Strombolituites* of Remelé³. Hyatt⁴ refers only very briefly to *Lituites*, which he does not define, but remarks that "the genus appears to be represented in the Calcareous of this country [N. America] by *Lituites Farnsworthi*, Bill., Pal. Foss. vol. i. 1861, p. 21, fig. 24, and *L. imperator*, Bill., ibid. p. 23 . . ." Perhaps also "*Gyroceras (Lituites) magnificum*, Billings"⁵, might be added to these, but its characters have not been clearly made out. If it be a *Lituites* it is the giant of its tribe, the discoidal spire being "about 8 inches in diameter, the produced free extremity at least 20 inches in length in the full-grown individuals." These dimensions throw the Swedish and German specimens completely into the shade. The *Lituites angulatus* of Saemann is relegated by Hyatt to the genus *Trocholites*, in which association it will be found in this Catalogue.

¹ Zeitschrift der Deutsch. geol. Gesell., Band xxxiv. 1882, Heft i. pp. 156-193, Taf. x., xi.

² Jahrb. der Königl. Preuss. geol. Landesanst. und Bergakad. zu Berlin f. d. Jahr 1883 (1884); "Beiträge zur Kenntn. der Cephalopoden aus Silurgesch. der Provinz Ost-Preussen," p. 101.

³ Zeitschr. der Deutsch. geol. Gesell., Band xxxiii. 1881, p. 192.

⁴ "Genera of Fossil Cephalopods," Proc. Boston Soc. Nat. Hist. vol. xxii. 1883, p. 267 (footnote).

⁵ Geol. Surv. Canada, Rep. of Progress, 1853-1856 (1857), p. 307.

The grouping here adopted for the family Lituitidæ is the following:—

LITUITES, Breyn, (restricted).

OPHIDIOCERAS, Barrande.

ANCISTROCERAS, Boll, emend. Noetling.

Lituites lituus, Montfort.

- ‡ 1731. Genus X. Tubuli Concamerati. Species i. *Superficie levi*; *Conici*; *Apice Spire modo intorto*; *Siphunculo inter Centrum & peripheriam* . . . Klein, Descrip. tubulorum marinorum, p. 10, tab. v. f. B.
- ‡ 1732. *Lituites*; *a me primo detectus*, &c. . . . Breynius, Dissertatio physica de Polythalamiis, p. 26, tab. ii. f. 11.
1775. *Sur tous les lituites*, &c. . . . Knorr & Walch, Recueil des Monumens des Catastrophes, tom. iii. pp. 139–141, tab. (Suppl.) iv. (after Breynius), tab. iv a. f. 1, tab. iv c. f. 1.
1808. *Lituites lituus*, Montfort, Conchyl. Systém. vol. i. p. 279.
1811. *Spirulites*, Parkinson, Organic Remains, vol. iii. p. 110, pl. vi. f. 11, pl. vii. ff. 18, 19 b?.
1820. *Orthoceratites undulatus*, Schlotheim, Petrefactenkunde, p. 55.
1820. *Lithuites convolvans*, Schlotheim, ibid. p. 59 (not of Hisinger).
1821. *Lituites perfectus*, Wahlenberg, Nova Acta Reg. Soc. Scient. Upsaliensis, p. 84.
1822. *Orthoceratites undulatus*, Schlotheim, Nachträge zur Petrefactenkunde, p. 58, Taf. xi. ff. 1, a, b.
1831. *Lituites lituus*, Hisinger, Anteckn. i Physik och Geognosie, Häft v. pp. 12, 105, & 112, tab. v. ff. 3, 3.
1837. *Lituites lituus*, Hisinger, Lethæa Svecica, p. 27, tab. viii. ff. 5, a, b.
- ‡ 1837. *Lituites convolvans*, Bronn, Lethæa Geognostica, Band i. 2nd ed. p. 103, Taf. i. f. 3 a, not b, c (not of Hisinger).
1849. *Orthoceratites undulatus*, Quenstedt, Petrefactenkunde Deutschlands, Band i. Abth. i. p. 44, tab. i. ff. 24, a, b, & f. 25.
1857. *Lituites perfectus*, Boll, Beitrag zur Kenntniss der Silur. Ceph., in Archiv für die Naturkunde von Mecklenburg, p. 30, tab. ix. f. 30, & ff. 31, a–e (*fide* Noetling).
1857. *Lituites striatus*, Boll, ibid. p. 31, tab. ix. fig. 31 f (*fide* Angelin & Lindström).
1860. *Lituites lituus*, Lossen, Zeitschr. der Deutsch. geol. Gesell., Band xii. p. 16, Taf. i. ff. 1, a–d.
1869. *Lituites perfectus*, Karsten, Verstein. in den Geröllen Schleswigs und Holsteins, p. 53, tab. xix. f. 3.
1880. *Lituites lituus*, Remelé, Ueber einige neue oder seltene Versteinierungen aus silurischen Diluvialgeschieben der Gegend von Eberswalde, in der Festchrift zur fünfzigjährigen Jubelfeier der Forstakademie Eberswalde, p. 216, tab. i. ff. 1, a, b; *Lituites applanatus*, Remelé, ibid. p. 240, tab. i. ff. 6, a, b.

1880. *Lituities perfectus*, Kjerulf & Gurlt, Die Geologie des südlich. und mittl. Norwegen, p. 68.
1880. *Lituities lituus*, Angelin & Lindström, Fragmenta Silurica, p. 8, tab. ix. f. 8.
1881. *Lituities lituus*, Schröder, Beiträge zur Kenntn. der in ost- und westpreussischen Diluvialgeschieben gefundenen Silurcephalopoden, in Schriften der physik.-ökonom. Gesell. zu Königsberg, Band xxii. Abth. i. p. 58.
1882. *Lituities lituus*, Noetling, Zeitschrift der Deutsch. geol. Gesell. Band xxxiv. Heft i. p. 156, Taf. x., xi.
1883. *Lituities lituus*, Noetling, Jahrb. der Königl. Preussisch. geol. Landesanst. und Bergakad. zu Berlin f. d. Jahr 1883 (1884), p. 129.

Sp. Char. The shell is at first discoid, the whorls about four in number, having an oval transverse section, contiguous (?), slowly increasing in diameter, afterwards produced into a long straightened piece, which is, however, slightly curved for a short distance after freeing itself from the coiled part. The rate of increase of the straightened part is about 1 in 8. The thin test consists of two layers, and the varying strength of the lines of growth gives it a wavy appearance, the outlines of the successive apertures being marked by a series of undulations, which are strong enough to leave their impress upon the cast. Finer lines of growth cover the whole of the test. The undulations form a shallow sinus on the ventral side of the shell, and project forwards on each side, thus producing lateral "saddles" which, increasing in height towards the aperture, there form two lobes or projections inclined towards each other, as seen in some Ammonites¹. The aperture is thus contracted, and presents a bifoliate figure when viewed from above. The septa are simple; about twelve may be counted in half a volution of the spiral part, when the diameter of the latter is 9 lines. The distance of the septa gradually increases with the growth of the shell. The body-chamber is 3 inches long in a specimen 11½ inches in length; its basal diameter is 13 lines, its apertural 18. The siphuncle is central in the coiled part of the shell, until the last whorl is reached, when it begins to take up its normal position, which is maintained throughout the straightened portion of the shell: this position is about $\frac{1}{3}$ of the distance across the dorso-ventral diameter, in the median line; it is scarcely inflated between the septa. The dimensions of a fine and nearly perfect example of this species, figured by Noetling (*loc. cit.* 1882), of the natural size, are as follows:—greatest diameter of the coiled part of the shell 10 lines, greatest

¹ A. Jason, e. g.

length of the entire specimen 1 foot 1 inch and 3 lines ; greatest diameter at the aperture $1\frac{1}{2}$ inch.

Remarks. The geographical distribution of *Lituities lituus* appears to be limited to North Germany and Sweden.

Horizon. *Orthoceras*-Limestone (= Arenig-Llanvirn).

Locality. Sweden.

Represented by a single example presented by S. P. Pratt, Esq.

Lituities ? Ibez, J. de C. Sowerby.

1839. *Lituities ? Ibez*, J. de C. Sowerby, in Murchison's Sil. Syst. pt. ii. p. 622, pl. xi. f. 6.

1848. *Orthoceras perelegans*, Salter (pars), Mem. Geol. Surv. vol. ii. pt. i. p. 354, pl. xiii. f. 4 (not ff. 2, 3, 3 a).

1849. *Hortolus Ibez*, d'Orbigny, Prodr. de Paléont. vol. i. p. 27.

1852. *Hortolus Ibez*, McCoy, British Pal. Foss. fasc. ii. p. 324.

1854. *Orthoceras perelegans*, Salter, in Murchison's 'Siluria,' pl. xxix. ff. 5, 6.

1873. *Orthoceras perelegans*, Salter, Cat. Cambr. and Sil. Foss. p. 187.

1873. *Orthoceras tracheale*, Salter, *ibid.* pp. 187, 192.

1882. *Lituities Ibez*, Blake, British Foss. Ceph. pt. i. p. 228, pl. xviii. ff. 3, 4, 4 a, 5.

[Not 1839. *Orthoceras Ibez*, J. de C. Sowerby, in Murchison's Sil. Syst. pl. v. f. 30.]

Sp. Char. J. de C. Sowerby gives no description of this species, but refers to his figure of it as representing "an arched portion of probably *Orthoceras Ibez*," which therefore approaches to *Lituities*, but we have not seen specimens perfect enough to settle the question.

Professor Blake (British Foss. Ceph. pt. i. p. 228) states that he was unable to find Sowerby's type specimen, which Salter identified with his *Orthoceras perelegans*.

The following is Blake's description of *L. Ibez*:—"The section, as Salter states in the description of his *O. perelegans*, is probably circular. The flattening always takes place in the plane of curvature. The radius of curvature is in none so small as in the type. In the smallest, almost reaching the apex, it is $\frac{5}{6}$ inch, and the curvature gradually decreases as the fragments are of larger diameter—and those which show the aperture are nearly straight there ; some also may have longer straight portions. The earlier portion forms an open coil, the whorls not being in contact. The greatest rate of increase observed is 1 in 9, and this decreases with the curvature to almost zero. The aperture is not contracted, but formed by a sigmoid curve, which bends rapidly forward on the convex side as to a beak ; it is concave forwards on the side, and curves back to

form a sinus on the inner side. The ornaments consist of, first, sharp non-separate ribs, at first $\frac{1}{2}$ the diameter apart, becoming closer to an average of $\frac{1}{3}$ the diameter, though appearing still closer by compression, and finally dying off on the body-chamber on approaching the aperture—these rather undulate, or are oblique, sloping backwards to the exterior; secondly, there are fine riblets parallel to these, numbering from 10 to 20 in the interval between two ribs, and degenerating into lines of growth on the unribbed part. The septa lie parallel to the ribs in the intervals between them, and are thus about $\frac{1}{3}$ the diameter apart; their convexity is between $\frac{1}{5}$ and $\frac{1}{6}$ the diameter. The siphuncle is small and central. The type is the longest species. The greatest diameter of the more curved part is $\frac{5}{8}$ inch."

Remarks. The specimen representing this species in the Collection consists only of a very small fragment, half buried in the matrix, but exhibiting the sculpture characterizing Sowerby's species. It is very doubtful if this is a *Lituities* at all, though the curvature of the apical portion in the type specimen figured by Sowerby suggests that the shell may have been at first coiled. The presence of *Lituities* in the British rocks must, for the present, be considered as very far from satisfactorily determined.

Horizon. Lower Ludlow.

Locality. Leintwardine, Herefordshire.

Represented in the Collection by a very small fragment presented by J. E. Lee, Esq., F.S.A., F.G.S.

Genus **OPHIDIOCERAS**¹, Barrande.

(*Ophioceras*, Barrande, 1865².)

Gen. Char. Shell consisting at first of numerous symmetrically coiled, contiguous whorls, with little or no central vacuity. The section is more or less rounded, but there is a flat band running along the peripheral margin which evidently results from the filling up of the ventral notch in the aperture. A portion of the last whorl finally frees itself from the coiled part and is produced into a short straight piece about $\frac{1}{4}$ of a whorl in length. The aperture is slightly expanded and trilobate, one of the lobes being longer than the other two (fig. 2, *d*). The sutures are simple. The siphuncle appears to vary in position according to the age of the individual; in the young it is nearly central, while in the adult it is very near

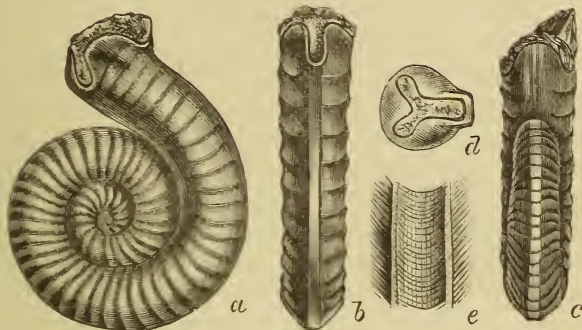
¹ Syst. Sil. de la Bohême, 1867, vol. ii. pt. i. p. 174.

² Ibid. 1865, vol. ii. pt. i. pls. xlv. & xevii.

the outer margin. The principal ornaments in all the known species are prominent transverse ribs.

Ophidioceras has a very limited range, being known only in the Silurian of England and Bohemia.

Fig. 2.



Ophidioceras simplex, Barrande.—*a*, lateral view of an adult specimen, showing the lobed aperture; *b*, convex side of the same, showing the smaller orifice, and the band or keel corresponding with it; *c*, front view of the same, showing the contracted border of the larger orifice; *d*, aperture viewed from above, showing its trilobate character, oriented to correspond with *a*; *e*, fragment of the band of *O. tessellatus*, Barr., showing its concave form and ornaments. Copied from Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. 1865, pl. xevii. ff. 6-9 & 19.

Remarks. *Ophidioceras* was considered by Barrande to be a subgenus of *Lituities*; but Professor Blake¹, who apparently is not convinced of the presence of lobes in the aperture of the latter, as described (though from imperfect material) by Lossen² and Noctling³, regards *Ophidioceras* as a distinct genus, only “remotely related” to *Lituities*. Hyatt places *Ophidioceras* “provisionally near *Ascoceras* [*i. e.* in the same family, *Ascoceratidæ*] on account of the Y-shaped aperture and form of whorl and costations;” but the extraordinary changes which the shell of *Ascoceras* passes through in the course of its growth, added to its peculiar septal characters, mark it off very distinctly from *Ophidioceras*⁴, whose alliance seems to be clearly with *Lituities*.

¹ British Foss. Ceph. 1882, pt. i. pp. 67, 68.

² Zeitschr. der Deutsch. geol. Gesell., Band xii. 1860, p. 15.

³ Ibid. Band xxxiv. 1882, p. 156.

⁴ See on this point Barrande, Syst. Sil. de la Bohême, vol. ii. 1877, Supplém. et Série tardive, p. 98, pl. cccxci. ff. 3-7; also Lindström, Geol. Mag. dec. iii. vol. v. (December, 1888), p. 532.

Ophidioceras articulatum, J. de C. Sowerby, sp.

1839. *Lituities articulatus*, J. de C. Sowerby, in Murchison's 'Sil. Syst.' pt. ii. p. 622, pl. xi. f. 5 (not f. 7).

1854. *Lituities Ibez*, Salter, in Murchison's 'Siluria,' pl. xxxi. f. 6.

1873. *Lituities articulatus*, Salter, Cat. Cambr. and Sil. Foss. p. 174.

1882. *Ophidioceras articulatum*, Blake, British Foss. Ceph. pt. i. p. 230, pl. xviii. ff. 14, 14 a, 15.

[Not 1852. *Lituities articulatus*, McCoy, British Pal. Foss. p. 323.]

Sp. Char. "The rate of increase, as measured, ranges from 1.43 to 1.29; but from the compression to which the specimens have been subjected, these measurements are seldom very reliable. The inner whorls are always just in contact—till the body-chamber, which leaves the coiled part at a diameter of from 9 to 14 lines, and continues straight for $\frac{2}{3}$ the greatest diameter. In an obscure fossil referred to this species from the Wenlock Shale, the uncoiled part reaches twice this distance. There is no sign in any of the slightest want of symmetry. The ribs are always direct, more or less separate, with a slightly backward direction towards the outside, from 26 to 28 per whorl. The front had a flattened band along it as shown by two smooth parallel lines in more than one example. The finer ornaments are parallel lines of growth, and the surface is occasionally pitted. The section when unflattened is uniformly rounded. The body-chamber consists of some part of the coiled portion; the ribs die out towards the aperture, which is not seen to be contracted. The septa are more remote than the ribs, being but 14 per whorl in the earlier part. The siphuncle is only seen in one example in the Wenlock Limestone, where it is nearly external, being preserved after the decay of the shell. The diameter is never more than $1\frac{1}{2}$ inches. The straight ribbing and the band along the front easily distinguish this from previously described British forms; but it is very similar to some of the other *Ophidioceras* figured by Barrande on plate xlv. of his Silurian Cephalopods (Syst. Sil. de la Bohême, vol. ii. pt. i. 1867), with none of which, however, it exactly agrees, but is nearest to *O. tenerum* or *O. simplex*. The contracted aperture has not, however, been seen in British examples." (*Blake.*)

Remarks. This is rather a rare species, and examples found in the British rocks are poorly preserved. A specimen in the Collection from the Wenlock shales of Nantglyn, Denbighshire, may possibly belong to the present species, but it is too much distorted for certain recognition; it shows the straight piece, and exhibits obscurely the characteristic transverse ribbing.

Horizon. Wenlock Shales, Lower Ludlow.

Localities. Dudley, Worcestershire; Nantglyn, Denbighshire (W. S.); Ludlow, Shropshire (L. L.).

Represented in the Collection by three examples, one of which (No. 37899) is figured by Blake (*loc. cit.* pl. viii. fig. 15).

Ophidioceras geometricum, Blake.

1882. *Ophidioceras geometricum*, Blake, British Foss. Ceph. pt. i. p. 231, pl. xviii. ff. 16, 16 a.

Sp. Char. "The rate of increase is 1·5 and the last whorl ·31 of the whole, the whorls being just in contact. The last chamber leaves the earlier whorls for some space. The character of the section is not seen. The aperture is bounded by sigmoid lines, and has an inflation on the inner side, giving it a proboscis-like form. The ornaments are subacute, separate ribs, which run radially, and appear to be lost on the front, which has the same appearance of a keel as in *Oph. articulatum*. There are 32 per whorl, but they die away on the straight portion, which has only lines of growth. The whorl is crossed by a number of sharp spider-lines, which pass across the ribs so as to transgress nearly a rib-interval in their passage outwards; these are eight per space. Diameter 1 inch.... Two other specimens from different localities show the peculiarities of this form; the rate of increase being 1·53, and the last whorl ·33 of the diameter. The aperture is seen only in the type. The ribs may be as few as 27 per whorl, and bent back towards the outside, but there is the same appearance of a keel, probably due to a flat band, in all, and the remarkable thread-like lines transgressing the ribs, 7 per space. No septal characters are anywhere seen.... The present species has a broader last whorl and greater rate of increase than any of those referred to *Oph. articulatum*. The ribs are perhaps not quite so straight; and, above all, though specimens of the last named, with ornaments perfectly preserved, have been seen, they do not show the remarkable transgressive threads of the present [species]." (*Blake*.)

Remarks. A specimen from Nantglyn, much crushed and distorted, is referred very doubtfully to this species. The ribbing, however, can be seen, and the shell appears to taper more rapidly than that of *Oph. articulatum*. It is also a larger shell than the latter.

Horizon. Wenlock Shales.

Localities. Dudley, Worcestershire; Nantglyn, Denbighshire.

Represented in the Collection by four specimens, one of which (No. 73896) is figured by Blake (*loc. cit.* pl. xviii. fig. 16).

Ophidioceras simplex, Barrande.

1867. *Ophidioceras* (*Lit.*) *simplex*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 184, pl. xcvi. ff. 1-12.

1877. *Ophidioceras simplex*, Barrande, *ibid.*, Supplém. et Série tardive, pl. cccclxxviii. Case i.

Sp. Char. The "crosse" or straight part of the shell is very short, scarcely $\frac{1}{2}$ an inch in length. The maximum number of whorls is three, both in large and in small examples; they are just in contact, the external being slightly marked by the internal whorls. There is a small vacuity in the centre. The transverse section is subtriangular. A very distinct flattened keel or band runs along the periphery. The body-chamber, including the straight part of the shell, occupies about half of the first volution; its aperture is much contracted, and three tongue-like lobes are formed thereby, one of which is a little longer than the other two, the whole forming a Y-shaped aperture. The longer of the three lobes corresponds with the ventral keel, which, in fact, results from the filling up of the extremity of this lobe, very much in the same way that the band in *Pleurotomaria* represents the "notch" in its aperture.

The septa are numerous and but slightly concave; they are not more than half a line distant from each other. The siphuncle is placed at a distance of about half a line from the convex or ventral border of the shell; its elements are cylindrical. The surface is ornamented with prominent, acute annulations, which strongly mark the cast; they are distant about $1\frac{1}{2}$ lines measured from the summit of one ridge to that of the neighbouring one, the distance varying a little with the age of the individual. The annulations become somewhat weaker as they approach the ventral keel; each one corresponds with a septal chamber, so that there is always a rib between two sutures. The latter, however, are slightly oblique to the annulations. The test is covered with very fine transverse lines, 3 to 4 in the spaces between the ribs, the summits of the latter being smooth.

Remarks. The following species, though evidently allied to the present one, differ in the following particulars:—*Ophid. rudens* (*infra*) by the possession of 5, instead of 3 whorls; *O. tessellatum* (*infra*) by the ornaments of the test.

Horizon. Étage E, bandes e 1 and 2 (=Salopian).

Localities. Karlstein, Dlauha Hora, Lochkow; Bohemia.

Well represented in the Collection.

Ophidioceras rudens, Barrande.

1867. *Ophidioceras* (*Lit.*) *rudens*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 183, pl. xlv. ff. 13-24.

1877. *Ophidioceras rudens*, Barrande, ibid. Supplém. et Série tardive, pl. cccclxxviii. Case ii.

Sp. Char. The straight piece in this species is very short, as in its congeners of the Bohemian basin, and is not more than from 10 to 12 lines in length. The number of volutions is from 4 to 5, and their breadth increases very slowly. The transverse section is elliptical, the concave side being a little truncated, while the convex shows the flattened keel characteristic of the genus. The body-chamber, including the straight part, occupies a little more than $\frac{3}{4}$ of the external volution. The aperture is contracted by the development of the dorsal and lateral borders, which are inclined towards the interior of the body-chamber. These form the Y-shaped orifices already described in other species of *Ophidioceras*. The septa are very close together, their average distance upon the sides of the shell scarcely amounting to 1 line. The siphuncle is placed at a little distance from the keel, and is composed of cylindrical elements. The surface of the test and of the cast is ornamented with numerous transverse annulations, each of which corresponds with a septal chamber. The annulations do not quite reach the ventral keel. A network of minute lines covers the test, and is chiefly developed upon the earlier volutions; the lines extend over the keel, where they form a backwardly directed sinus.

Remarks. *Ophidioceras rudens* is distinguished from all allied forms in the Bohemian rocks by the greater number of its whorls, viz. 4 to 5 instead of 3.

Horizon. Étage E, bande *e* 1 (=Salopian).

Locality. Butowitz, Bohemia.

Represented in the Collection by a single example.

Ophidioceras tessellatum, Barrande.

1867. *Ophidioceras* (*Lit.*) *tessellatus*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 186, pl. xcvii. ff. 13-19.

Sp. Char. The general appearance of this species strikingly recalls that of *Ophidioceras simplex*. The straight piece is short, but it is not perfect in any specimens seen. The number of volutions amounts to two, with part of a third. The transverse section is subtriangular, the concave side being scarcely impressed by the preceding whorl.

On the opposite side is a groove between two prominent ridges; the whole forming the ventral keel. The body-chamber, including the straight piece, occupies nearly half of the external volution. The aperture is unknown, but there is reason to suppose that it resembled that of *Ophidioceras simplex*. The septa are distant about $\frac{1}{2}$ a line measuring from suture to suture, upon the sides of the shell, and a little more than this upon the periphery. The siphuncle is situated at a little distance from the ventral or convex border of the shell, and is composed of small cylindrical segments, similar to those of *Ophidioceras simplex*. The surface of the shell and of the cast is ornamented with prominent nearly transverse annulations, each corresponding with a septal chamber, the direction of the former not however, coinciding perfectly with the latter. The finer ornaments consist of a network of minute raised lines, which are more distinct in the spaces between the annulations than upon them. The longitudinal lines of this network appear to become obsolete upon the last whorl, so that they may belong only to the younger stages of the growth of the shell, in which case their specific importance would be greatly reduced.

Remarks. This species is very closely allied to *Ophidioceras simplex*, from which it is distinguished only by its ornaments.

Horizon. Étage E, bande e 2 (= Salopian).

Locality. Hinter Kopanina, Dlauha Hora, Butowitz, Bohemia.

Fairly well represented in the Collection.

Family TROCHOCERATIDÆ.

Genus **TROCHOCERAS**, Barrande¹.

[*Lituities*, J. de C. Sowerby, 1839²; *Lituities*, Hall, 1847³; *Lituities*, M'Coy, 1852⁴; *Hortolus*, M'Coy, 1852⁵; *Lituities*, Morris, 1854⁶;

¹ Haidinger's Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, Band iii. September 1847, p. 266; also Syst. Sil. de la Bohême, vol. ii. pt. i. p. 74.

² Murchison's Sil. Syst. pt. ii. p. 643 (*L. cornu-arietis*).

³ Pal. New York, vol. i. p. 52, pl. xiii. ff. 1 a, 1 b (excl. ff. 1, 2, 3 of same plate, and pl. xiii. (bis) f. 1).

⁴ British Pal. Foss. fasc. ii. p. 323.

⁵ Ibid. p. 324 (*H. giganteus*).

⁶ Cat. British Foss. 2nd ed. p. 305.

Lituities, Salter, 1855¹; *Lituities*, Eichwald, 1860²; *Gyroceras*, Winchell & Marcy, 1865³; *Sphyradoceras*, Hyatt (pars), 1883⁴; *Trocholites*, Hyatt⁵ (pars), 1883.]

Gen. Char. Shell more or less helicoidal, composed of few whorls, the number rarely exceeding two, all of them exposed. The enrolment is sometimes dextral, sometimes sinistral, examples of the former, however, being by far the most numerous. The transverse section is subcircular, or elliptical, more rarely subquadrangular. The body-chamber is scarcely dilated, but there is sometimes a slight constriction near the aperture. The proportions of the body-chamber vary from $\frac{1}{6}$ to $\frac{1}{1\frac{1}{2}}$ the length of the entire shell. The aperture is simple and conforms to the outline of the body-chamber; there is a slight emargination in the median line of the convex border. The septa are rather approximate, their distance varying between $\frac{1}{4}$ and $\frac{1}{1\frac{1}{2}}$ the ventro-dorsal diameter. The siphuncle varies in position from near the centre to the external or convex margins, but in one species (*Troch. secula*, Barr.⁶) it is internal; its elements are slightly inflated between the septa.

Trochoceras ranged from the Cambrian to the Devonian, but the genus attained its highest development in the Silurian. It has been described under the name *Lituities* from North America (Canada⁷) and Sweden from rocks of Cambrian and Ordovician age respectively, while the Silurian rocks contain abundant species in Bohemia, England, and the United States. Several species are recorded from the Devonian of the last-named country⁸, and one species from rocks of Lower Devonian age in France⁹. The specimen from Germany (Nassau) described by the Brothers Sandberger under the name

¹ British Pal. Foss. fasc. iii. Appendix, p. viii (*L. cornu-arictis*).

² Lethæa Rossica, vol. i. p. 1298.

³ Mem. Boston Soc. Nat. Hist. vol. i. p. 102.

⁴ Proc. Boston Soc. Nat. Hist. vol. xxii. p. 298.

⁵ Ibid. p. 267, *Trocholites* (*Lituities*) *undatus*.

⁶ Syst. Sil. de la Bohême, vol. ii. pt. i. pl. xxx. ff. 1-6.

⁷ *L. Farnsworthi*, Billings (Pal. Foss. vol. i. 1861-1865, p. 21), is in all probability a *Trochoceras*; it is certainly not a *Lituities*, as that genus is defined by Lossen and Noetling, whose interpretation is adopted in this Catalogue. It is more difficult to speak of the other species recorded by Billings, because they are not figured, but, judging by the descriptions of *L. imperator* and *L. Apollo*, these also belong to *Trochoceras*. To the last-named may be referred likewise *L. undatus*, Hall (see *infra*, p. 41).

⁸ Hall, Pal. New York, 1879, vol. v. pt. ii. p. 390.

⁹ *Trochoceras Lorierei*, Barr., from Sarthe:—'Défense des Colonies,' iii. p. 278.

*Trochoceras? serpens*¹ belongs in all probability to some other genus; it is only a fragment.

Remarks. By a singular coincidence Professor Hall, some years after Barrande's description of *Trochoceras* in Haidinger's 'Berichte' (1847), described certain forms from the Devonian rocks of North America (Pal. New York (1852), vol. ii.) and gave them the same generic name. There is, however, no question of priority involved, as Barrande's publication of the genus preceded that of Hall by nearly five years.

It may be added that Barrande divided *Trochoceras* into 2 series, Exogastric and Endogastric; but the latter is represented by only one species in Bohemia, and none in Britain. He also separated the annulated from the smooth forms, &c.

a. *Species without annulations.*

***Trochoceras lamellosum*, Hisinger, sp.**

1837. *Lituities lamellosus*, Hisinger, Lethæa Svecica, p. 28, tab. viii. f. 7.

1849. *Lituities lamellosus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 27.

[Not 1880. *Discoceras lamellosum*, Angelin & Lindström, Fragmenta Silurica, p. 10, pl. ix. f. 12, pl. x. ff. 3-5, pl. xv. f. 30.]

*Sp. Char.*² The portion of the shell known, which is all septate, consists of about 2 whorls, in which no asymmetry can be seen. The section is transversely elliptical, the ratio of the two diameters being as 12:17. The whorl increases its diameter about $2\frac{1}{2}$ times in a volution. The septa are very approximate, their distance very slowly increasing with the growth of the shell; they are about 1 line apart where the diameter of the shell is 8 lines, and nearly 2 lines apart where the shell-diameter has increased to 10 lines. These measurements are taken upon the sides of the shell. The siphuncle lies between the centre and the ventral side. The ornaments consist of fine transverse striæ, annulations being entirely absent.

Remarks. There is a discrepancy between the figures of this species in the 'Fragmenta Silurica' and Hisinger's original figure in

¹ Die Versteinerungen des Rheinischen Schichtensystems in Nassau, 1856, p. 175, tab. xv. f. 1.

² The following is Hisinger's description:—" *Lituities lamellosus* testa discoidea; anfractibus contiguis, rotundatis dorso applanatis, ultimo....; septis numerosissimis; siphone dorsali."

the 'Lethæa Svecica,' the septa being represented as much wider apart in the former illustrations than they are in the latter. The distance of the septa is an important point, because that is one of the characters that separates *Trochoceras lamellosum*, His., from *T. convolvans*, His., as may be seen by a comparison of the figure of the former species in the 'Lethæa Svecica,' tab. viii., with that of the latter in the 'Anteckningar i Physik och Geognosie,' 1831, Heft v. tab. v.

Feeling quite satisfied that the *Discoceras lamellosum* of Angelin and Lindström is really the *Trochoceras* ("*Lituities*") *convolvans* of Hisinger, I have placed it in the synonymy of the latter species.

The specimen in the Collection which I have referred to the present species has remarkably close septa, which coincide with Hisinger's figure, but not with those of the 'Fragmenta Silurica.' No portion of the free whorl is seen in our specimen, nor is the test preserved.

Horizon. *Orthoceras*-Limestone (= Arenig).

Locality. Sjurberg (Kopparberg¹), Sweden.

Represented in the Collection by a single imperfect example presented by Sir Roderick Murchison.

***Trochoceras convolvans*², Hisinger, sp.**

1821. *Lituities imperfectiores*, Wahlenberg, Nova Acta Reg. Soc. Scient. Upsaliensis, p. 84.

1831. *Lituities convolvans*³, Hisinger, Anteckn. i Physik och Geognosie, Femte Häftet, p. 60, tab. v. ff. 2, 2.

1837. *Lituities convolvans*, Hisinger, Lethæa Svecica, p. 27, tab. viii. f. 6.

1880. *Discoceras convolvans*, Angelin & Lindström, Fragmenta Silurica, p. 10, tab. ix. f. 12 (not tab. xvi. ff. 3 a-c).

1880. *Discoceras lamellosum*, Angelin & Lindström, *ibid.* p. 10, tab. x. ff. 3-5, tab. xv. f. 30.

[Not 1820. *Lithuities convolvans*, Schlotheim, Petrefactenkunde, p. 59.

—1860. *Lituities convolvans*, Eichwald, Lethæa Rossica, vol. i. Seconde Section de l'ancienne Période, p. 1297.]

Sp. Char. Shell discoid, with three and a half whorls, the last

¹ The ancient province of Dalecarlia or Dalarne.

² The following is Hisinger's description of his species:—*Lituities convolvans* testa discoidea, spirali, anfractibus contiguis, teretibus, striatis, ultimo prolongata; septis approximatis; siphone dorsali....Diam. 3-4 uncias Par. [Parisian inches].

³ d'Orbigny (Prodr. de Paléont. Stratigr. vol. i. p. 27) renamed it *Lituities Hisingerii*, presumably to distinguish it from *L. convolvans*, Schlotheim, which is, however, the *L. lituus*, Breyn., and is therefore not synonymous with Hisinger's species; hence d'Orbigny's name is superfluous.

prolonged in a larger curve beyond the rest, leaving in one example a space measuring 9 lines between the concave margin of the free portion and the convex margin of the coiled part. The diameter of the whorls increases about twice in each volution. The section appears to be nearly circular, the superior lateral angles being rounded¹. The septa are numerous, about 35 in a volution; their distance apart increases very slowly, it is about $\frac{1}{5}$ the shell-diameter. The siphuncle is placed at a distance of about $\frac{1}{5}$ the shell-diameter from the convex margin, and is very slightly inflated between the septa. The surface is ornamented only with transverse lines of growth.

Remarks. This species is readily distinguished from *Trochoceras lamellosum* by the greater distance of its septa, and by its less rapid rate of increase.

Horizon. *Orthoceras*-Limestone (= Arenig).

Locality. Kinnekulle Hill (Westrogothia), Sweden.

Represented in the Collection by a single imperfect example.

***Trochoceras speciosum*, Barrande.**

1867. *Trochoceras speciosum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 95, pl. xiv. ff. 12-15.

1882. *Trochoceras speciosum*, Blake, British Foss. Ceph. pt. i. p. 219, pl. xxviii. f. 3, pl. xxix. ff. 1, 2.

Sp. Char. Shell discoid and flattened, although the internal whorl is slightly elevated helicoidally. The enrolment is dextral. The transverse section is oval, the two axes nearly as 6:5, the longest being the ventro-dorsal. The rate of increase of the last whorl is as 1:2. The body-chamber, which is not quite complete, occupies about $\frac{1}{3}$ of the outer whorl. The form of the aperture is not known, but it probably agrees with that of the transverse section. The septa are very close together, about 15 may be counted in the space of 1 inch, beginning at the base of the body-chamber; they are but very slightly concave. The siphuncle is placed close to the convex border; it is composed of short, rather thick segments, having an oval section. The segments are considerably contracted at the necks. The diameter of the siphuncle is about $\frac{1}{5}$ the ventro-dorsal diameter of the shell. Only fragments of the test have been seen, they show no ornament.

Remarks. "Two of the specimens referred to this species show

¹ The section of this species has never been figured, and the specimen in the British Museum is too imperfect to afford any reliable information on this point. The shape of the section is therefore inferred from Hisinger's figures.

an almost exact correspondence with all its characters, but those that are flattened and distorted do not agree so well. . . . The whorls scarcely touch, owing to the want of symmetry. The section is elliptic, the long diameter in the plane of curvature being $13\frac{2}{3}$ lines, when the short is 11 lines. The surface was probably smooth. The septa are 32 or even more in half a whorl; they are nearly straight at first and then bend rapidly forward to the front, and are almost flat transversely. The siphuncle is external and bulbous. The only other smooth, little elevated *Trochoceras* in British strata is *T. tortuosum*, whose section at once distinguishes it. Among the Bohemian forms *T. anguis* has a less proportionate thickness of whorl, and *T. priscum* . . . has a compressed front [it is also a much larger species with wider septa]." (*Blake*.)

Horizon. Wenlock Limestone.

Locality. Dudley, Worcestershire.

Represented in the Collection by a single example.

***Trochoceras priscum*, Barrande.**

1848. *Trochoceras priscum*, Barrande, in Haidinger's Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, Band iv. p. 208.

1867. *Trochoceras priscum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 92, pl. xii. ff. 8-11, pl. xv. ff. 16-19, pl. xix. ff. 12-17.

Sp. Char. Shell consisting of 3 whorls, forming a helicoid spiral. Transverse section oval, of which the (slightly) smaller end corresponds with the convex border of the shell. The ratio of the ventro-dorsal to the transverse diameter varies between 9:8 and 6:5. The rate of increase is but slight, being as 1:2 for the two external whorls. The body-chamber touches the preceding whorl throughout its whole extent: its length slightly exceeds its basal diameter. The form of the aperture coincides with that of the transverse section. The distance between the septa increases very slowly, the maximum attained not exceeding $\frac{1}{9}$ the diameter of the shell. Their transverse convexity is slight, but the ventro-dorsal reaches $\frac{1}{4}$ the shell-diameter. The siphuncle is placed close to the convex border; its elements are cylindrical. The test appears to be quite smooth.

Remarks. The species that comes nearest to this is *T. anguis*, Barr. (pl. xvi.), which, however, has a more rounded section and closer septa.

Horizon. Wenlock Limestone.

Locality. Dudley, Worcestershire.

Represented in the Collection by a single example.

Trochoceras tortuosum?, J. de C. Sowerby.

1839. *Lituities tortuosus*, J. de C. Sowerby, in Murchison's Sil. Syst. pt. ii. p. 622, pl. xi. f. 3.
 1867. *Trochoceras oxynotum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 91, pl. xiv. ff. 1-11.
 1882. *Trochoceras tortuosum*, Blake, British Foss. Ceph. pt. i. p. 221, pl. xxi. ff. 3, 3a.

Sp. Char. Shell increasing its diameter about twice for each volution. "The outer whorls slightly overlap the inner, and scarcely any elevation is observable. The section is rounded-lanceolate, rising to the greatest thickness at $\frac{1}{3}$ the whorl-breadth from the umbilical edge, whence there is a gentle slope to the front, which is subangular. Ratio of thickness to breadth as 13 to 18. No ornaments. The shell is of considerable thickness. The septa bend slightly backwards on the inner side of the whorl, and then rapidly forwards, meeting at an angle on the front. They are very numerous, 50 per whorl; the septal surface has a convexity of $\frac{2}{9}$ the long diameter of the whorl, the inner part being flatter. The siphuncle is external in the angle at the front, and has a diameter on the septal surface of $\frac{1}{9}$ the whorl-diameter. Diameter about 30 lines." (*Blake.*)

Remarks. Sowerby's type is in the collection of the Geological Society. It is stated by Professor Blake to consist of two pieces, of which the larger one only was figured; when put together the two "form an ordinary involute *Trochoceras*."

There seems good reason for supposing that the present species is identical with Barrande's, the very remarkable form of the whorl suggesting this connection; the two forms agree also in other particulars, such as septal characters, position of siphuncle, &c. A large specimen in the British Museum, though somewhat crushed, compares very well with Barrande's figure of *T. oxynotum* (pl. xiv. ff. 9-11) in the closeness of the septa, and the numbers and proportions of the whorls.

Horizon. Wenlock Shales.

Localities. British: Dudley, Worcestershire; ? Garcoed, Usk, Monmouthshire.—*Foreign:* Kosorz, Bohemia.

Represented in the Collection by four specimens, about one of which there is no information; it is in all probability from the Lower Ludlow of the West of England. Another of the British examples (No. C. 2018) was presented by J. E. Lee, Esq., F.G.S.

Trochoceras distortum, Barrande.

1865. *Trochoceras distortum*, Barrande, Défense des Colonies, iii. p. 33.

1867. *Trochoceras distortum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 98, pl. xxviii. ff. 11-14.

Sp. Char. Shell very clearly asymmetrical, when a sufficiently large portion is seen. The enrolment is sinistral. There appear to be only two whorls, which are in great part disconnected. The transverse section is elliptical; the ventro-dorsal is to the transverse axis as 7:8, there being a tendency to a subquadrate form. The rate of increase is about 1 in 14, measured upon a fragment figured by Barrande (pl. xxviii.). The length of the body-chamber is apparently about twice the diameter of its base. The septa are numerous, their distance from each other equalling about $\frac{1}{10}$ of the ventro-dorsal diameter. The siphuncle is close to the convex border; its elements are slightly inflated between the septa. The test, preserved in the specimen from Néhou, marked only with fine lines of growth which conform to the contour of the whorls.

Remarks. The nearest ally of this species is *Trochoceras Davidsoni*, Barrande (pl. xxvii.), but the latter has a more rapid rate of increase, wider septa, and a more quadrate section.

Horizon. Étage G (=Downtonian). Devonian.

Localities. Tetin, Lochkow, Bohemia; Néhou (Manche), France; (Devonian).

Fairly well represented in the Collection.

Trochoceras Davidsoni, Barrande.

1848. *Trochoceras Davidsoni*, Barrande, in Haidinger's Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, Band iv. p. 208.

1867. *Trochoceras Davidsoni*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 89, pl. xxvii. ff. 1-7.

Sp. Char. Shell with only about two whorls, which are distinctly asymmetrical, and not contiguous in any examples met with. The enrolment of the whorls is sinistral. The transverse section of the body-chamber is subquadrangular, but it is nearly circular in the septate part; the ratio of the ventro-dorsal to the transverse diameter is as 5:6. The shell increases its diameter about three times in the course of the last volution. The body-chamber occupies nearly half of the last whorl. The septa are distant about $\frac{1}{8}$ the ventro-dorsal diameter of the shell, measured at the upper part of the septate portion. The siphuncle is very near the convex border, sometimes not quite in the median line of the ventro-dorsal diameter; its elements are slightly inflated in the

upper part, so as to give them a conical appearance when seen in section. There are no traces of annulations upon the shell. The test, which is very thick in adult specimens near the aperture, is ornamented with subregular striæ of growth, which form a sinus both upon the ventral and the dorsal sides of the shell. On each side of the aperture, close to the convex side, the test forms an expansion or prominent wing-like fold. These aliform projections strikingly resemble those developed upon the shell of *Gyroceras alatum*, Barr. (pl. xlv.). There is a second pair of projections at the base of the body-chamber in *Trochoceras Davidsoni*, just as there is upon the body-chamber of *G. alatum*. They have not been seen upon the septate part of the present species, though, as observed by M. Barrande, their absence may be due to bad preservation.

Remarks. *Trochoceras Davidsoni* is distinguished from the other smooth species by its size, by the subquadrangular form of its transverse section, by the great relative size of the body-chamber, and by the aliform projections with which it is ornamented. But for its asymmetry this species might have been referred to *Gyroceras*, to which it may be perhaps a connecting form through *G. alatum*.

Horizon. Étage F (= Downtonian).

Locality. Konieprus, Bohemia.

Fairly well represented in the Collection.

***Trochoceras secula*, Barrande.**

1848. *Cyrtoceras secula*, Barrande, in Haidinger's Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, Band iv. p. 208.

1867. *Trochoceras secula*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 127, pl. xxx. ff. 1-6.

1877. *Trochoceras secula*, Barrande, ibid. Supplém. et Série tardive, p. 239, pl. dx. ff. 1-5.

Sp. Char. Shell scarcely attaining a complete volution, and but slightly asymmetrical. The enrolment of the whorls is dextral. The section is elliptical, the slightly smaller extremity corresponding with the concave side of the shell. The ventro-dorsal is to the transverse axis as 4:3. The shell increases its diameter about three times in the course of the last volution. The length of the body-chamber equals $\frac{1}{4}$ that of the entire shell. The plane of the aperture is slightly inclined towards the concave side. The septa are distant from each other $\frac{1}{7}$ the ventro-dorsal diameter, and their convexity is equal to $\frac{1}{4}$ of the same. The siphuncle is placed close to the concave border, but without touching the test, its elements

are nummuloidal. The test is ornamented only with fine striæ of growth.

Remarks. *Trochoceras secula* and *T. inexpectatum*, Barr. (Syst. Sil. de la Bohême, 1877, vol. ii. pt. i., Supplém. et Série tardive, p. 87, pl. cccxcxi.), are the only species of *Trochoceras* in which the siphuncle is endogastric. There appears to be nothing to distinguish these two species from *Meloceras*¹, save their want of symmetry and greater curvature.

Horizon. Étage E (=Salopian).

Locality. Lochkow, Bohemia.

Represented in the Collection by two examples.

***Trochoceras boreale*, Foord.**

Sp. Char. Shell discoid, compressed, whorls in contact, about three in number, all exposed. Section elliptical, the ratio of the two diameters about as 6 : 8 ; siphuncle between the centre and the convex side. Septa approximate ; two lines apart on the sides, where the shell has a diameter of 11 lines, increasing to $2\frac{1}{2}$ lines where the diameter is $1\frac{1}{2}$ inches. Body-chamber and test unknown. There are no indications of ribbing or of any other ornaments upon the cast.

Remarks. This is a much larger species than any of those of the Niagara rocks of North America that come at all near to it. *Trochoceras Aeneas*, Hall², agrees with it in the distance of the septa and position of the siphuncle, but the section is different, and there are marks of very distinct annulations upon the cast. Salter³ described, amongst other Arctic Silurian fossils, one which he called "*Lituities* —, n. sp.;" but this is stated to have six or seven whorls at least, and therefore it could have no affinity with the present species. There was, therefore, no other course but to give this form a new name.

Horizon. Silurian.

Locality. Wellington Channel, Arctic America.

Represented in the Collection by one example, collected by Captain Inglefield.

¹ See Part I. of this Catalogue, p. 269.

² 20th Ann. Rep. of the Univ. of the State of New York, revised edition, 1870, footnote explanation of plate xxv. f. 16.

³ Journal of a Voyage in Baffin's Bay and Barrow Straits in the years 1850-1851, by Dr. P. C. Sutherland (1852), Appendix, p. ccxxii.

b. *Annulated Species.***Trochoceras subcostatum**, Angelin, sp.

1880. *Discoceras subcostatum*, Angelin, in Angelin & Lindström's Fragmenta Silurica, p. 10, tab. ix. ff. 13, 14, tab. xi. ff. 5-8.

Sp. Char. The shell consists of about three whorls, in which, judging from Angelin's figure, there is very little asymmetry. The last whorl leaves the coiled portion and is prolonged into a free curved piece for a distance of half the last volution, and is there broken off, so that the aperture is not seen. The section is subquadrate, the ventral side being considerably flattened, as represented in Angelin's figure. The shell increases its diameter about $2\frac{1}{2}$ times in the course of a volution. The septa are very close together, their distance being everywhere about the same, viz. from 1 to $1\frac{1}{2}$ lines; they are moderately concave. The siphuncle is situated between the centre and the ventral or convex border. The surface of the test is ornamented with obscure transverse annulations and rather coarse lines parallel to them, which form a conspicuous backwardly directed sinus on the periphery.

Remarks. The above description is taken partly from Angelin's, as the specimen in the British Museum is not sufficiently perfect to furnish all the characters of the species, the operations of the lapidary, before it came into the possession of the Museum, having reduced it to a very thin slab, which, however, shows the outline of the whorls, and the commencement of the free portion, as well as the septa and siphuncle.

This species is distinguished from *T. lamellosum*, Hisinger, sp., by its ornaments and by its narrower and less rapidly increasing whorls.

Horizon. *Orthoceras*-Limestone (= Arenig).

Locality. Kinnekulle Hill (Westrogothia), Sweden.

Represented in the Collection by a single example presented by J. E. Lee, Esq., F.S.A., F.G.S.

Trochoceras regulare, Blake.

1882. *Trochoceras regulare*, Blake, British Foss. Ceph. pt. i. p. 221, pl. xxix. f. 7.

Sp. Char. The shell increases its diameter about twice in the last whorl. "The section is a rather flattened oblong, rounded at the edges. The whorls slightly overlap, and there is decided asymmetry. The ornaments consist of very clean and separate backward-curving ribs, 22 per whorl, which stand out from the flat

surface in the centre of the whorl, but die away partially over the front. The whole is so covered with the shell that no septal characters are observable, and it is unknown how much belongs to the body-chamber. . . . No other example of this very distinct form has been seen. In shape it is nearest *Nautilus quadrans*, but its ornaments are different." (*Blake*.)

Remarks. This is a well-characterized species, and is now admirably represented in the Collection, several specimens having been added since the above description was published. Many of these show the inner whorls, which are wanting in the type; there are about $2\frac{1}{2}$ whorls, with a large central vacuity. One of the specimens has a portion of the shell (about $\frac{1}{2}$ an inch) projecting in a straight direction beyond the coiled part, and at its extremity the rounded margin of the aperture is seen in outline, the shell being half buried in the matrix. The test is marked only with faint lines of growth for a distance of about 1 inch before the aperture is reached, the annulations becoming a little less prominent just before this smooth part begins.

Horizon. Wenlock Limestone.

Locality. Dudley, Worcestershire.

Represented in the Collection by numerous specimens, including the type described and figured by Professor Blake.

***Trochoceras giganteum*, J. de C. Sowerby, sp.**

1839. *Lituites giganteus*, J. de C. Sowerby, in Murchison's Sil. Syst. pt. ii. 622, pl. xi. f. 4.

1852. *Hortolus giganteus*, M'Coy, British Pal. Foss. fasc. ii. p. 324.

1865. *Trochoceras giganteum*, Lyell, Elements of Geology, 6th ed. p. 552.

1873. *Trochoceras giganteum*, Salter, Cat. Cambr. and Sil. Foss. pp. 160, 174.

1882. *Trochoceras giganteum*, Blake, British Foss. Ceph. pt. i. p. 223, pl. xxxi. ff. 1, 2.

Sp. Char. The shell increases to the extent of about three times its own diameter in the last whorl, the latter being out of contact with the first whorl for about half its length. "In several examples otherwise agreeing with the type, decided asymmetry is observed; in one of the figured specimens (fig. 2) this is associated with the peculiar form of aperture to be noticed below. The sub-quadrate section is characteristic, though the earlier whorls are more rounded. The breadth is always greater than the thickness—the proportion increasing with growth. In the other figured specimen it reaches a maximum of 22:16. The front is usually rounded, but tends to become concave. The inside also when out of contact retains some concavity. The ribs are rather of irregular

character, being sometimes rounded, sometimes more acute, but always rough [? eroded]. On the average they are about $\frac{1}{5}$ the whorl-breadth apart, or 26 per whorl, growing closer with age. They are direct on the inside when exposed, and curve back on the sides to meet at a rounded angle on the front, where they either become feebler with intermediate ribs, or break up into smaller ones; the whole are generally continued to the aperture, but the ribs are sometimes replaced by lines of growth. The surface is seldom well enough preserved to show the parallel lines of growth on the ribs, but often the epidermids of the under layer are visible. These are direct, crossing the ribs, from 14 to 22 per line. There are also longitudinal ones on the inner side when exposed. The body-chamber always includes part of the normally-coiled portion, and extends a variable distance in a nearly straight line. The largest seen was 8 inches long, but it is impossible to say what proportion this bore to the coiled portion. This and several smaller ones show no difference on approaching the aperture, which seems to be indicated by the deep back-curving ribs; but in one or two instances there is a decided contraction just at the aperture on each side of the whorl, as in fig. 2, dividing it, as seen in full view, into two wider portions, separated by a narrower, and yet not forming a contracted aperture in the same sense as in the *Phragmocerata*. The septa are direct across the front; but on the sides, their general direction being radial, they become concave at some part, so that they cut across the ribs, and do not coincide with the epidermids, and they thus, on the whole, become sigmoid in form. They do not bear a fixed proportion to the ribs, but are sometimes more, sometimes fewer, the last few being closer, up to $\frac{2}{11}$ the whorl-breadth. The convexity of the septal surface is pretty constant at about $\frac{1}{4}$ the whorl-breadth. The siphuncle is nearly invariable, a little beyond [above] the centre." (*Blake.*)

Remarks. This species bears a general resemblance to *T. optatum*, Barrande (pl. xxiii.), but the septa are much closer, and the siphuncle, according to Prof. Blake, is nearer the centre. The finer ornaments of the test, which are very characteristic in *T. optatum*, and consist of regular longitudinal striæ crossing the ribs and the interspaces, have not been seen in the present species. It should be remarked that the figure of *T. giganteum* given by Professor Blake does not agree in some points with that of Sowerby, though both are alleged to have been drawn from the type specimen.

Horizon. Lower Ludlow.

Locality. Leintwardine, Herefordshire.

Represented in the Collection by two examples.

Trochoceras rapax?, Barrande.

1867. *Trochoceras rapax*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 124, pl. xxi., pl. xxii. f. 1.
 1867. *Trochoceras pingue*, Barrande, ibid. p. 112, pl. xvii. ff. 5-9.
 1877. *Trochoceras rapax*, Barrande, ibid. Supplém. et Série tardive, p. 89, pl. cccxciii. ff. 1-3.
 1882. *Trochoceras rapax*, Blake, British Foss. Ceph. pt. i. p. 225, pl. xxx. ff. 2, 2 a.

Sp. Char. This species was known to Barrande only by fragments, representing the body-chamber and a few septal chambers. The asymmetry, though not considerable, is sufficient for recognition. The rate of increase in the body-chamber is 1 in 13. The section is subquadrate, being a little flattened in front. The septa are distant from each other about $\frac{1}{5}$ the diameter close to the body-chamber, their convexity representing nearly $\frac{1}{4}$ of the ventro-dorsal diameter. The siphuncle is subcentral, inclining towards the convex border; its elements are cylindrical. The ornaments consist of very prominent annulations, $3\frac{1}{2}$ lines apart where the shell-diameter is 15 lines; they scarcely, however, mark the cast. They are strongly bent backwards, making a deep sinus along the convex border, and completely encircle the shell, showing that it must have been evolute throughout a considerable portion of its length. A network of striae covers the test, though only the transverse lines can be distinguished with the naked eye.

Remarks. This species attains considerable dimensions, a large fragment figured by Barrande (pl. xxii. f. 1) measuring 300 mm. in length and 230 in its greatest breadth. Professor Blake (*loc. cit.* p. 226) observes that "the general structure of this shell, the shape of the section, the position of the siphuncle, the character of the ribbing, are very much the same as in *Trochoceras giganteum*, to which the specimens have been hitherto referred. But in the type of the latter . . . the whorls are in contact." I quite agree with Professor Blake that there is nothing to distinguish this species from *T. pingue*, Barrande.

The specimen in the Collection which I have referred to *T. rapax* is more perfect than any of those figured by Barrande, a considerable part of the coiled portion being preserved, the ribbing and the septa are well shown, but the finer ornaments are wanting. The shell is much compressed, and therefore it appears to be of a less robust habit than *T. rapax*, but there is no other species so near to it.

Horizon. Wenlock Shale.

Locality. Dudley, Worcestershire.

Represented in the Collection by a very fine specimen.

Trochoceras arietinum ?, Barrande.

1867. *Trochoceras arietinum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 103, pl. xvii. ff. 1-4, pl. xxv. ff. 1-3, pl. ciii. ff. 8-11.

1882. *Lituites? arietinus*, Blake, British Foss. Ceph. pt. i. p. 227, pl. xxxi. ff. 4, 4a.

Sp. Char. The specimen figured by Barrande (pl. xxv.), although exhibiting very little of the body-chamber, shows that the shell was composed of at least two entire whorls. The asymmetry, though not very well marked, is sufficiently apparent. The enrolment is dextral. The transverse section is an oval of which the ventro-dorsal is to the transverse axis as 4:5; it is flattened upon the convex border. The body-chamber appears to have been of considerable length, probably occupying about $\frac{1}{2}$ the external whorl. The septa are moderately distant from each other, being about $\frac{1}{4}$ the ventro-dorsal diameter apart near the body-chamber. The siphuncle is at a little distance from the centre, towards the convex border. The ornaments consist of acute and separate transverse annulations which curve obliquely backwards, becoming obsolete along the convex border, where there are only lines of growth. These follow the same direction as the annulations, being faint upon the sides, but becoming stronger on the convex border. There are obscure traces also of longitudinal lines on the concave side.

Remarks. Professor Blake remarks (*loc. cit.* p. 228) that "the only differences between our English specimens and the Bohemian are that the section is not transverse in the former; but none of the specimens are uncompressed; also that no longitudinal lines have been observed, and the septa are a little wider apart. The remarkable proportions, the flatness of the front, and the character of the ribs, including their dying off on the front [border], are well exemplified."

One of the specimens which I have doubtfully referred to the present species is embedded in a slaty rock, and is consequently very badly preserved; the pressure, however, coming from above, rather than laterally, has not distorted the outline of the fossil. About $2\frac{1}{4}$ inches of the straight portion is seen, and this is less crushed than the coiled part. The other example is more satisfactory. In this the annulations agree in character with Barrande's figures, and they appear to become obsolete on the outer border of the shell, a crucial character of this species. The septa are seen to be wide apart, another feature in common with *T. arietinum*.

Trochoceras arietinum is distinguished from *T. rapax* by the proportions of its whorls and its more delicate ribbing.

Horizon. Wenlock Shales, Lower Ludlow.

Locality. Llangollen, Denbighshire (W. S.): Ledbury, Herefordshire (L.-L.).

Represented in the Collection by two examples, one of which (No. C. 1998) was presented by J. E. Lee, Esq., F.G.S.

***Trochoceras equisetum*, Blake, sp.**

1839. *Phragmoceras?* *nautilium* (pars), J. de C. Sowerby, in Murchison's Sil. Syst. pt. ii. p. 622, pl. x. f. 2 (not f. 3).

1832. *Cyrtoceras* (?) *equisetum*, Blake, British Foss. Ceph. pt. i. p. 181, pl. xxx. f. 7.

Sp. Char. "The section is doubtful, but at present the surface of the side exposed is uniformly convex. The curvature is very great, the mean radius being $1\frac{1}{2}$ inches where the diameter of the whorl is about $1\frac{1}{4}$ inches. Thus, though the specimen is imperfect at the smaller end and there are no signs of contact of an earlier whorl, the appearances are almost those of a coiled shell. The rate of increase is about 1 in 15, measured along the outer curve. The ornaments are very rough irregular risings, curving rapidly backwards from the inner edge, and covered with parallel irregular lines of growth. Possibly 3 inches of mean length belong to the body-chamber. There is no sign of any change towards the aperture, which will be similar to the general ribbing, and therefore have a deep sinus on the front. The septa are rather remote, being from $\frac{1}{4}$ to $\frac{1}{5}$ the present diameter of the whorl apart, or 9 in the quarter circumference seen. The sutures curve rapidly forwards towards the convex side, cutting across several lines of ornaments. The siphuncle is external. Its elements are much narrower than their length, and have a conical shape, enlarging towards the aperture, and suddenly decreasing on passing each septum. The diameter across the shell is about $3\frac{1}{2}$ inches, and the greatest diameter of the whorl is $1\frac{1}{3}$ inches." This is Professor Blake's description of the specimen which he selected as the type of his species. He thus remarks upon its affinities:—"If this be a *Cyrtoceras*, there is very little doubt of its distinctness from all others; none of those showing so much curvature being anything like it. On the other hand, if it be a *Trochoceras*, its peculiar siphuncle, combined with the irregularity of its ribbing, separate it well from all those in which those characters are known."

Remarks. Of the two interpretations given by Professor Blake

I have adopted the latter, as I think that the balance of evidence is strongly in favour of this species belonging to the genus *Trochoceras*, and that its alliances are with such species as *T. speciosum*, Barr., *T. tortuosum*, Sow., &c.

Horizon. Lower Ludlow.

Locality. Parkes Hall, near Dudley (?).

Represented in the Collection by a single very imperfect example.

Trochoceras Sandbergeri, Barrande.

1848. *Trochoceras Sandbergeri*, Barrande, in Haidinger's Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, Band iv. p. 208.

1867. *Trochoceras Sandbergeri*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 114, pl. xviii. ff. 7-12, pl. xxix. ff. 1-9.

‡ 1867. *Trochoceras trochoides*, Barrande, ibid. p. 116, pl. xxix. ff. 16-26.

Sp. Char. Shell having a little more than two whorls, increasing its diameter about three times for each volution. The transverse section is subquadrangular near the aperture, the external border being the broadest. The ventro-dorsal diameter of the body-chamber is to the transverse as 5 : 4. The body-chamber projects from the coiled part of the shell for a distance of about $\frac{1}{3}$ of its own length in a nearly straight direction. There is a very perceptible constriction near the aperture, which is quite distinct even upon the cast. The septa are moderately distant from each other, *i. e.* $\frac{1}{5}$ of the shell-diameter. The siphuncle is situated about midway between the centre and the convex border. The ornaments of the test consist firstly of prominent transverse annulations, which are not so conspicuous upon the body-chamber as upon the septate part of the shell; they run backwards with a very considerable obliquity, and form a shallow sinus along the convex border. The finer ornaments consist of a network of raised thread-like lines, of which the most prominent are the longitudinal ones, and they are also much wider apart than the others, which they cross.

Remarks. *Trochoceras pulchrum*, Barr. (pl. xxviii.), is a nearly related form, but the whorls increase more rapidly than those of the present species, and the ribs are more numerous. *T. trochoides*, Barr. (pl. xxix.), is coarser in its form and sculpture than the species under description.

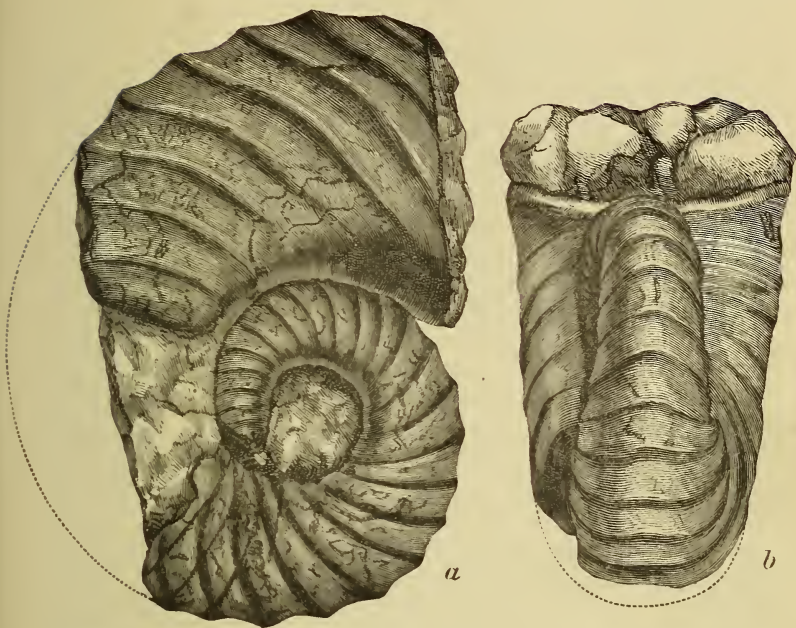
Horizon. Étage E (=Salopian).

Locality. Dlauha Hora, Bohemia.

Well represented in the Collection.

Trochoceras subquadratum, Foord.

Fig. 3.



Trochoceras subquadratum.—*a*, lateral view ; *b*, front view, showing the slight asymmetry of the whorls. Drawn from a specimen in the Collection. Natural size.

Sp. Char. The asymmetry of the whorls in this species is very slight, though quite perceptible; about $1\frac{3}{4}$ whorls are seen. The rate of tapering is rapid, the shell increasing its diameter about three times for each volution. The section is subquadrate. The septa are moderately distant from each other, being about 2 lines apart on the sides of the shell, where the ventro-dorsal diameter of the latter is about 9 lines. The ornaments consist of prominent, acute annulations which bend obliquely backwards on the sides of the shell, and form a broad and rather deep sinus on the convex border. The siphuncle is not seen, nor is the test preserved.

Remarks. This species is most nearly allied to *Trochoceras mirandum*, Barr. (Syst. Sil. de la Bohême, 1867, vol. ii. pt. i. p. 108, pl. xvi. ff. 1-4), from which it is, however, distinguished by its more rapid rate of increase, and by the greater distance separating the ribs.

Horizon. Woolhope Limestone.

Locality. Hay-head, East of Walsall, Staffordshire.

Represented in the Collection by a single example.

Trochoceras striatum, Blake.

1882. *Trochoceras striatum*, Blake, British Foss. Ceph. pt. i. p. 222, pl. xxix. f. 5, pl. xxx. ff. 3, 4, 4 a, 4 b.

Sp. Char. The shell increases its diameter about twice in the last whorl. "The want of symmetry is very slight. The section is uniformly rounded, but rather flattened. The body-chamber continues the same curve as the earlier portion. The ornaments are 33, almost obsolete, rounded, subseparate ribs, curving very rapidly backwards, and these die away on the body-chamber, leaving only lines of growth. The septa are 24 per whorl, and the sutures are somewhat sigmoid, commencing by being slightly convex towards the aperture, on the inner edge. There are some bulbous-looking bodies on the circumference which may represent an external beaded siphuncle. Diameter 3 inches. . . . Other examples confirm the great rapidity of growth [*i. e.* rate of increase], and the breadth of the outer whorl. The thickness is about $\frac{1}{2}$ the breadth, and in some there are very good indications of asymmetry. The body-chamber is not longer than its basal diameter, and the aperture is formed of a gentle sigmoid backward tending curve parallel to the lines of growth, about $\frac{1}{9}$ the diameter apart. . . . The shell, when well preserved, is covered by fine lines parallel to the ribs, which are most conspicuous towards the convex border, while epidermids cover the region near the concave border. The septa are pretty uniformly concave; except near the inner border, their transverse convexity is slight; and their number pretty constant at 24 per whorl. The siphuncle is not certainly determined." (*Blake.*)

Remarks. The specimen in the Collection which I have referred to the present species is badly preserved, but the wide septa and the ornaments (of which fragments are seen) are so characteristic of Blake's species that I have very little hesitation in identifying it therewith.

Horizon. Wenlock Shales.

Locality. Dudley?, Garcoed, Usk, Monmouthshire.

Represented in the Collection by two examples, one of which (No. C. 2017) was presented by J. E. Lee, Esq., F.G.S.

Trochoceras cornu-arietis, J. de C. Sowerby, sp.

1839. *Lituities cornu-arietis*, J. de C. Sowerby, in Murchison's Sil. Syst. pt. ii. p. 643, pl. xx. f. 20, pl. xxii. f. 18 (varieties α & β).
1843. *Lituities cornu-arietis*, var., Portlock, Report on the Geology of Londonderry, p. 383, pl. xxviii. B. f. 7.
1849. *Lituities Sowerbianus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 1.
1852. *Lituities cornu-arietis*, M'Coy, British Pal. Foss. fasc. ii. p. 323.
1855. *Lituities cornu-arietis*, Salter, ibid. Appendix A, p. viii.
- ? 1860. *Lituities cornu-arietis*, Eichwald, Lethæa Rossica. vol. i. Seconde Section de l'ancienne Période, p. 1298.
1882. *Lituities cornu-arietis*, Blake, British Foss. Ceph. pt. i. p. 217, pl. xxi. ff. 6, *a* ; pl. xxviii. f. 5 (Portlock's figured specimen).
- [Not 1845. *Lituities cornu-arietis*, de Verneuil, in Murchison, de Verneuil, and de Keyserling's Géol. de la Russie d'Europe, vol. ii. pt. iii. p. 359, pl. xxv. ff. 7 *a*, *b*.]

Sp. Char. The description of the type specimens by Professor Blake runs as follows :—" There are two so-called varieties of this species, according to Sowerby, and they have apparently somewhat different characters. In the example, var. α , which is merely an external cast, the rate of increase is 1.42, last whorl .33 of the diameter. The several whorls are just in contact, all exposed, fitting closely to the centre, and not quite symmetrical; they are 3 in number, and there is no straight portion. Section apparently rounded; thickness $\frac{7}{10}$ the whorl-breadth. The ribs are backward curving, not clearly separate, becoming wider apart with age, and covered by parallel riblets. Diameter 16 lines. From Caradoc Sandstone, Corton, near Presteign. In the other example, var. β , the rate of increase is only 1.2, and the last whorl .3 of the whole, so that the inner whorls are partially concealed. It is now compressed, and thus has an acute front [convex side], but the sides are uniformly convex. The ribs are sharp, and about 27 per whorl, curving backwards towards the convex side, and are covered by parallel riblets. No septal characters are seen. From the Lower Llandovery Shales. Both the specimens are in the Museum of the Geological Society."

Professor Blake further observes that "in all the collections examined [by him] there are but few examples of either of these forms, and they do not range themselves definitely in two groups as though there were two species, but are most satisfactorily considered as belonging to one rather variable one." A specimen figured by Blake shows that the ornaments change with growth. "In the first $1\frac{1}{2}$ whorls they are merely fine riblets, only occasionally rising to a

stronger one, but later on fairly strong ribs are developed, still covered by the riblets, and all curving back as in the type. We are thus permitted to consider that var. α represents the young form and var. β the more adult, accounting for the difference of dimensions by the distortion and compression. . . . The septa are uniformly concave, but make a backward sinus on the front [convex border], and there are 32 per whorl."

Remarks. This species is represented in the Collection by a single imperfect specimen, in which, however, the acute ribs and the coarse striations parallel to them are well shown. This specimen, which is from the Ordovician of Norway, is larger than the one figured by Blake from the Bala Beds of Sholeshook, measuring nearly 4 inches across. The transverse diameter of the outer whorl (which is the only one seen) is $1\frac{1}{2}$ inches. The ribs form a broad sinus upon the periphery. The chambers are filled with crystalline calcite, and the siphuncle is not seen.

Horizon. Étage 5 α (Bala Series).

Locality. Herö, Norway.

Trochoceras optatum, Barrande.

1867. *Trochoceras optatum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 111, pl. xxiii. ff. 5-10.

1877. *Trochoceras optatum*, Barrande, ibid. Supplém. et Série tardive, p. 87, pl. cccxcv. ff. 5-8.

Sp. Char. This is one of the largest species in the Bohemian basin. Adult examples do not possess more than two whorls, in which the want of symmetry is very apparent, the inner whorl having its apical portion elevated above the plane of the outer one upon which it rests. The outer whorl frees itself from the inner for the distance of about $\frac{1}{4}$ of a whorl, thus leaving a considerable space between the two, and resembling in this respect *Ophidioceras*. The transverse section is nearly circular. The shell enlarges regularly and somewhat rapidly in diameter, the latter increasing about four times in a complete volution. The body-chamber occupies that part of the last whorl which is free from the preceding one. Its capacity is greater than that of the rest of the shell, of which it forms nearly one half of the length. The aperture is oval, the ratio of the ventro-dorsal diameter to the transverse being as 9 : 8. The septa, in the vicinity of the body-chamber (where the shell has a diameter of 15 lines), are about $\frac{1}{6}$ that diameter distant from each other; their convexity about $\frac{1}{5}$ the ventro-dorsal diameter. The siphuncle is close to the convex border; its elements are cylindrical. The ornaments consist of oblique, acute, and prominent annulations,

well marked on the sides and back of the shell, but becoming almost obsolete upon the concave side of the body-chamber. The annulations form a deep backward pointed sinus upon the convex border of the shell; they are as distinctly seen upon the cast as upon the test, but become obsolete close to the aperture in adult examples. The annulations are 5 lines apart where the shell has a diameter of $1\frac{1}{2}$ inches. The surface of the test is ornamented with fine, slightly waved, and regular longitudinal striæ, which pass over the annulations; there are about 5 of these striations in the space of 1 line. A slight raised line or keel along the median line of the convex border is visible upon the cast in some examples. Epidermids are also seen upon the cast.

Remarks. This species is distinguished from all others of the same group by its size, by the position of the siphuncle, and by the absence of fine transverse lines upon the test.

Horizon. Étage E (=Salopian).

Locality. Kosořz, Lochkow, Bohemia.

Fairly well represented in the Collection.

Trochoceras trochoides, Barrande.

1867. *Trochoceras trochoides*, Barrande, Syst. Sil. de la Bohême, vol. ii pt. i. p. 116, pl. xxix. ff. 16-26.

Sp. Char. The number of whorls in this species scarcely amounts to two; its asymmetry is very distinct, the inner whorl being elevated above the plane of the outer. The transverse section is nearly circular, though the transverse is to the ventro-dorsal axis as 10 : 9. The shell increases its diameter about three times in the last volution. The body-chamber is in contact with the other whorls, except for a very short distance near the aperture. The latter is slightly sinuated on the convex border. The greatest distance of the septa from each other as measured on the sides of the shell, in the median line, is 2 lines, which equals about $\frac{1}{5}$ of the ventro-dorsal diameter. The siphuncle is midway between the centre and the convex border; its elements are cylindrical. The surface of the shell is ornamented with very prominent oblique annulations, which are as strongly marked upon the cast as upon the test. They form a deep sinus upon the convex border. The test is covered with a beautiful network of prominent raised lines, forming rectangular meshes. The longitudinal lines are a little stronger, and much less numerous than the transverse ones which they cross. The former are exactly 1 line apart, near the aperture, while it would require at least four of the latter to fill that space.

Remarks. The sculpture in the present species is very similar to that of *T. Sandbergeri*, Barr., but it differs in other respects, as already pointed out. A specimen in the Collection from the Wenlock of England, which exhibits no tendency to asymmetry, is somewhat doubtfully referred to this species, on account of its coarse ribbing; it is a cast.

Horizon. Étage E (=Salopian); Wenlock Limestone.

Localities. *British.* West of England?—*Foreign.* Lochkow, Kosořz, Bohemia.

Well represented in the Collection.

Trochoceras nodosum, Barrande.

1848. *Trochoceras nodosum*, Barrande, in Haidinger's Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, Band iv. p. 208.

1867. *Trochoceras nodosum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 110, pl. xxv. ff. 7-18.

Sp. Char. Shell with two whorls, which are contiguous excepting for a very short distance near the aperture. The want of symmetry is quite perceptible. The enrolment is sinistral. The transverse section is subquadrate, the ventro-dorsal slightly exceeding the transverse diameter. The rate of increase is rapid, the shell increasing its diameter about three times in the last volution. The body-chamber occupies about half the length of the external whorl, and has a slight sinus on the convex border. The septa are about $\frac{1}{4}$ the shell-diameter apart. The siphuncle is placed about midway between the centre and the convex border. The ornaments consist of slight oblique annulations which are developed chiefly on the sides of the shell, scarcely at all on the concave border, and terminating at the edge of the convex side in a nodule or small elongated protuberance. The surface of the test is ornamented with a network of subregular raised lines. The longitudinal lines which are the stronger are about $\frac{1}{2}$ a line apart, upon the body-chamber, while from 3 to 4 of the transverse lines can be counted within that space. The surface of the cast of the body-chamber is covered with epidermids, which are sometimes visible to the naked eye.

Remarks. The ornaments of *T. nodosum* distinguish it from those species which in other respects resemble it. Professor Hyatt points out that in many of the characters of this species, such as the flattened sides and periphery, and the aperture, it resembles *Barrandeoceras*, q. v.

Horizon. Étage E (=Salopian).

Localities. Dworetz, Lochkow, Bohemia.

Trochoceras asperum, Barrande.

1848. *Trochoceras asperum*, Barrande, in Haidinger's Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, Band iv. p. 208.
 1867. *Trochoceras asperum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 104, pl. xvi. ff. 8-16, pl. xix. ff. 18, 19.
 1882. *Trochoceras asperum*, Blake, British Foss. Ceph. pt. i. p. 218, pl. xxix. f. 3.

Sp. Char. The shell in this species consists of two whorls in which the asymmetry is but slight. The enrolment is sometimes dextral, sometimes sinistral. The transverse section is elliptical, the dorso-ventral diameter being in the ratio of 6 to 5 to the transverse. The shell increases its diameter about twice in the course of the last volution. The body-chamber leaves the coiled portion and is continued in a straight line, the length of the freed portion, however, varying in different individuals. The ornamentation consists of acute, oblique annulations, whose average distance from summit to summit is about 2 lines; they form a deep sinus on the convex side of the shell, and are but feebly marked on the concave side. The test is covered with longitudinal lines which are very variable, and are crossed by much finer transverse lines. The septa are numerous, their average distance apart, as measured at the sides of the shell, being about $1\frac{1}{2}$ lines. Their surface is strongly convex, but they are only slightly curved. The siphuncle is midway between the centre and the convex border.

Remarks. Professor Blake has identified this species in the British Silurian. He observes that "the chief difference between these [British examples] and the Bohemian type is the rarity of any longitudinal lines, but these are variable, and may easily be lost in the preservation of the fossil. Nevertheless a somewhat similar fossil from the Upper Ludlow shows longitudinal lines, but this may be a distinct species, e. g. *Trochoceras Sandbergeri*. The septal characters also render the determination doubtful, yet the general proportions and ornaments, especially the nature of section, which is rare among *Trochocerata*, the prominence of the ribbing, and the changes in the body-chamber, which are the chief features in the Bohemian, are seen in the English examples."

The straightness of the body-chamber and the character of the ribbing distinguish *T. asperum* from other Bohemian species.

Horizon. Étage E (=Salopian).

Locality. Wiskočilka, Bohemia.

Represented in the Collection by a single example.

Trochoceras degener, Barrande.

1848. *Trochoceras degener*, Barrande, in Haidinger's Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, Band iv. p. 208.

1867. *Trochoceras degener*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 121, pl. xxviii. ff. 15-21.

Sp. Char. This species has never been found with the coiled part complete, but in examples from which the matrix has been removed a slight amount of asymmetry is observable. The section is subquadrate, the ventro-dorsal diameter slightly exceeding the transverse. The shell increases its diameter about three times in half a whorl. The body-chamber occupies about half of the total length of the fossil. The aperture is a little oblique. The septa are distant from each other about $\frac{1}{4}$ the diameter. The siphuncle is situated about midway between the centre and the convex side; its elements are cylindrical. The surface is ornamented with rather low, rounded annulations, of slight obliquity, which form a shallow sinus on the convex side. The whole of the test is covered with a network of very fine and regular lines; the longitudinal, which are the stronger, are less than half a line distant from each other, the transverse lines are about three times as numerous as the former.

Remarks. *Trochoceras æquistriatum*, Barr. (pl. xxix.), resembles the present species in its general form and ornaments, but the ribs are obsolete upon the body-chamber, and the siphuncle is differently placed. The finer ornaments of *T. degener* are repeated in several species, such as *T. Sandbergeri*, *T. trochoides*, &c.

Horizon. Étage E (=Salopian).

Locality. Lochkow, Bohemia.

Well represented in the Collection.

Trochoceras disjunctum, Barrande.

1867. *Trochoceras disjunctum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 122, pl. xxii. ff. 2-7.

Sp. Char. The shell never attains a complete volution, but when the initial point is preserved it is not far short of one. The asymmetry is very slight. The transverse section is nearly circular. The shell increases its diameter nearly four times in the course of a volution. The body-chamber occupies about half the length of the entire shell. The aperture, whose plane is oblique to the long axis of the shell, is slightly sinuated on the ventral border. The septa are distant about $\frac{1}{5}$ the shell-diameter, and their convexity is also about $\frac{1}{5}$ of the same. The siphuncle is situated about mid-

way between the centre and the convex border; its elements are cylindrical. The surface is ornamented with prominent, rounded annulations which are oblique to the long axis of the shell, and are as strongly marked upon the cast as upon the test. The annulations are widest upon the back of the shell, where they form a shallow sinus; they are equally well developed upon the sides and upon the concave curvature of the shell. The finer ornaments consist of a network of minute lines, of which the longitudinal are slightly the stronger. The latter are about $\frac{1}{2}$ a line distant from each other in the centre part of the surface of the shell. Of the small (transverse) lines from 6 to 8 may be counted in the space of $2\frac{1}{2}$ lines. The surface of the cast of the body-chamber is covered with epidermids.

Remarks. The most nearly related species to *Trochoceras disjunctum* is *T. trochoides* (*ante*, p. 35), which is distinguished by its more closely contiguous whorls.

Horizon. Étage E (=Salopian).

Localities. Lochkow, Kosorz, Bohemia.

Well represented in the Collection.

Trochoceras pulchrum, Barrande.

1848. *Trochoceras pulchrum*, Barrande, in Haidinger's Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, Band iv. p. 208.

1867. *Trochoceras pulchrum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 113, pl. xxviii. ff. 1-8.

Sp. Char. Shell consisting of two complete whorls, which are markedly asymmetrical. The transverse section is elliptical, the ratio of the ventro-dorsal to the transverse axis being as 8 : 7. The shell increases its diameter about three times in the course of the last volution. The body-chamber, although disconnected from the rest of the shell, preserves its curvature; it occupies about one half of the last volution. The aperture has a slight emargination upon the convex side. The septa are distant about $\frac{1}{4}$ the shell-diameter. The siphuncle is very small, and is placed close to the centre, but towards the convex side; its elements are cylindrical. The surface is ornamented with very oblique acute annulations, which are numerous (about 36 in the last volution) and form a deep sinus upon the periphery. They become obsolete near the base of the body-chamber, and are replaced by lines of growth, the internal cast being here quite smooth. Fine transverse lines follow the course of the annulations, and they are crossed by less numerous longitudinal lines, of which 3 or 4 may be counted in the space of

half a line. The test in some specimens retains its natural colour in the shape of red longitudinal, irregular bands, which follow the course of the volutions up to the border of the aperture. The breadth of these bands, at the base of the body-chamber, is about half a line, and they are separated by a similar space of a whitish colour.

Remarks. The species most nearly allied to *T. pulchrum* are (1) *T. amicum* (Syst. Sil. Boh. pls. xv., xxviii.), which has, however, more contiguous whorls, not so central a siphuncle, and the annulations covering the whole surface of the body-chamber; and (2) *T. asperum* (pl. xvi.), in which the body-chamber is straightened after freeing itself from the septate part of the shell, the siphuncle is farther from the centre, and the annulations cover the entire surface of the septate part of the shell, including nearly the whole of the body-chamber.

Horizon. Étage E (=Salopian).

Locality. Butowitz, Bohemia.

Well represented in the Collection.

Trochoceras Americanum?, Billings.

1857. *Gyroceras (Lituities) Americanum*, Billings, Geol. Surv. Canada, Rep. of Progress for the years 1853-1856, p. 309.

Sp. Char. "Tube long, slender, gradually tapering; section semi-elliptical; dorsal aspect nearly flat; side and ventral aspect convex, and ornamented with prominent annulations, which, in leaving the lateral angles, are at first deflected towards the aperture at a sharp angle, and then curved towards the apex, crossing the ventral side nearly at right angles to the length, or with but a slight undulation towards the apex. The annulations are upon the average five lines and a half distant from the summit of one ridge to that of the next, the intervening spaces being regularly convex [? concave]; the surface is further marked by coarse striæ following the curves of the lateral and dorsal annulations; on the flat dorsal surface, where these latter do not appear, the striæ curve in the direction of the smaller extremity of the fossil. The dorso-ventral and lateral diameters appear to be about equal in the fragments examined, which are, however, somewhat distorted: the siphuncle is small and slightly eccentric, being nearest the dorsal aspect; the septa are convex and distant four lines.

"The length of the longest fragment measured along the outside curve is twelve inches, its greatest diameter one inch and a half, and the least one inch, thus tapering at the rate of about half a line to the inch; at least one third of the outer whorl remains, and shows

by its curvature that the diameter of the discoidal spire was four inches and a half nearly.

"This species is closely allied to *Lituities* (*Trochoceras*) *giganteus*, Sowerby, but differs in its more round dorsal aspect, and in the annulations being extended quite across. . .

"*Formation and Locality*.—Upper Silurian, Port Daniel, Gaspé [Lower Canada]." (*Billings*.)

Remarks. The specimen which I have referred to Billings's species is a fragment, apparently of the body-chamber, as no septa are visible. It is very distinctly cylindrical in section, the ratio of the dorso-ventral to the transverse diameter being as 25:21. The annulations are very strong and completely encircle the shell, forming a deep and narrow sinus upon the flat ventral side. They are about 7 lines distant from each other at the thickest part of the fossil, where the dorso-ventral diameter is 2 inches. Traces of fine longitudinal lines are visible in one part of the shell, but the surface is everywhere much eroded, and nothing is seen of the coarse transverse striæ described by Billings.

The dimensions of the British Museum example are the following:—Length, measured along the outer curvature, 8 inches; the same, inner curvature, 3 inches 10 lines; greatest diameter (dorso-ventral), 2 inches; least, 1 inch 4 lines.

Horizon. Niagara Group (Wenlock).

Locality. Wabash, Indiana.

Trochoceras Halli, Foord.

1847. *Lituities undatus*, Hall, Palæontology of New York, vol. i. p. 52, pl. xiii. ff. 1 a, 1 b, 2 a? (excl. ff. 2, 3, also pl. xiii. (bis) f. 1).

1857. *Lituities undatus*, Chapman, Annals & Magazine Nat. Hist. 2nd series, vol. xx. p. 117.

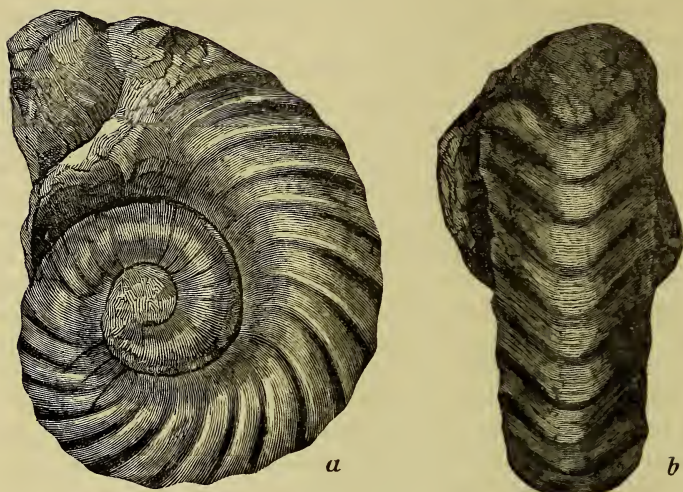
1863. *Lituities undatus*, Billings, in Logan's Geol. of Canada, p. 156, and Appendix, p. 951.

1883. *Trocholites undatus* (pars), Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 267.

Sp. Char. The shell, which is not complete, consists of two volutions; the asymmetry is slight, but quite discernible. The shell increases its diameter about three times in the last volution. The section is distinctly subquadrate, the ventral side being the broadest, as well as being considerably flattened. The surface is ornamented with oblique, rounded, not very prominent annulations, divided by concave interspaces of about equal width. The annulations bend backwards on the ventral side, and there form a deep sinus; while on the dorsal or concave side, approaching the um-

bilicus, they become quite obsolete; the young shell is almost smooth. The entire surface of the test is covered with very fine transverse lines both on the ribs and the interspaces, and there are

Fig. 4.



Trochoceras Halli. — *a*, lateral view; *b*, ventral or peripheral view, showing the deep sinus formed by the annulations. Drawn from a specimen in the Collection. Natural size.

also obscure traces of longitudinal lines. The septa are a little more than 1 line apart, where the shell has a ventro-dorsal diameter of 6 lines. The siphuncle is not seen.

Remarks. On looking at the table of references above, it will be observed that I have incorporated in the present species certain of the forms figured by Hall under the name of "*Lituities*" *undatus*. The others figured by that author upon the same plate, and also the one upon plate xiii. (bis), belong to the genus *Trocholites*, as pointed out by Hyatt¹.

It was suggested many years ago by Professor E. J. Chapman², of Toronto (Canada West), that the specimens obtained by the Geological Survey of Canada, from the Black River Limestone, at Lorette, near Quebec, and known under the name of *Lituities undatus*,

¹ Proc. Boston Soc. Nat. Hist. 1883, vol. xxii. p. 267. It is singular that this author should have overlooked the obvious distinctness of some of these forms from the rest, and that he should have included them all in *Trocholites*.

² Ann. & Mag. Nat. Hist. 1857, 2nd series, vol. xx. p. 117.

could not be properly referred to the genus *Lituities*, in which Hall had placed them. But d'Orbigny's genus *Cryptoceras*¹, in which Professor Chapman suggested that the Lorette specimens should be placed, is very imperfectly characterized, the ventral position of the siphuncle, upon which d'Orbigny relied, being a feature common also to *Trochoceras*. It may be added that *Cryptoceras* now falls into the synonymy of *Solenocœilus*, Meek & Worthen².

Horizon. Black River (=Llanvirn Series—lower part).

Locality. Lorette, near Quebec, Canada.

Represented in the Collection by two examples.

Family NAUTILIDÆ.

Genus **TROCHOLITES**, Conrad³.

[*Nautilus*, J. de C. Sowerby, 1839⁴; *Clymenia*, Eichwald, 1842⁵; *Lituities*, de Verneuil, 1845⁶; *Lituities* (pars), d'Orbigny, 1849⁷; *Lituities*, Saemann, 1854⁸; *Lituities*, Salter, 1855⁹; *Lituities* (*Trocholithus*), Schmidt, 1858¹⁰; *Lituities*, Lossen, 1860¹¹; *Lituities*, Roemer, 1861¹²; *Discoceras*, Barrande (pars), 1867¹³; *Discoceras* (*Lituities*), Kjerulf, 1879¹⁴; *Discoceras* (pars), Angelin & Lindström, 1880¹⁵; *Palæoclymenia*, *Palæonautilus* (subgenera), Remelé, 1881¹⁶; *Lituities*, F. Roemer, 1885¹⁷.]

Gen. Char. Shell depressed, planorbiform, having three or four involute whorls, transversely elliptical to subquadrangular in

¹ Prodrome de Paléontologie, 1849, vol. i. pp. 58 & 114.

² See in this volume under *Solenocœilus*.

³ Ann. Geol. Report, 1838, p. 119; see also Journ. Acad. Nat. Sci. Philadelphia, 1842, vol. viii. pt. ii. p. 274, which contains the revised generic description of *Trocholites* (see Pal. of New York, 1847, vol. i. p. 192).

⁴ Sil. Syst. pt. ii. p. 642.

⁵ Die Urwelt Russlands, Heft ii. p. 33.

⁶ Géologie de la Russie d'Europe, vol. ii. pt. iii. p. 360. *L. Odini* = *L. teres*, Eichw., Schichtensyst. von Esthland, 1840, p. 105, which supersedes it.

⁷ Prodr. de Paléont. Stratigr. vol. i. p. 1.

⁸ Palæontographica, Band iii. p. 166.

⁹ In Sedgwick & McCoy's British Pal. Foss., Appendix A, p. vii.

¹⁰ Archiv für die Naturkunde Liv-, Ehst- und Kurlands, p. 198.

¹¹ Zeitschr. der Deutsch. geol. Gesell. Band xii. p. 23.

¹² Die Foss. Fauna der Silurisch. Diluvial-Geschiebe von Sadewitz, p. 62.

¹³ Syst. Sil. de la Bohême, vol. ii. pt. i. p. 177.

¹⁴ Udsigt over det sydlige Norges geologi, Atlas, pl. xvi. (*Discoceras* (*Lituities*) *antiquissimum*).

¹⁵ Fragmenta Silurica, p. 10 (*Discoceras convolvens*; not of Hisinger).

¹⁶ Zeitschr. der Deutsch. geol. Gesell. Band xxxiii. Heft i. p. 13.

¹⁷ Lethæa Erratica, in Palæont. Abhandl. Band ii. Heft v. p. 68.

section. Siphuncle subcentral, or near the concave border. Body-chamber exceeding half a volution in length. Septa numerous, the sutures forming a shallow sinus upon the ventral surface of the shell; necks long, extending from septum to septum, and thus constituting the "holochoanoidal" siphuncle of Hyatt¹. The ornaments of the test consist of more or less prominent annulations, which are apt to become obsolete upon the body-chamber.

Remarks. Conrad's description of *Trocholites* is as follows²:—"Involute; symmetrical; whorls contiguous; the back of inner volutions rounded, fitting into a corresponding groove; septa convex; siphuncle near the inner margin.

"This genus differs from *Lituites* in having a submarginal siphuncle, and in not being extended into a straight or bent prolongation. The aperture is widely different, being of a lunate outline, whilst in *Lituites* it is nearly round."

Following this definition of the genus comes Conrad's description of his species *Trocholites planorbiformis*, which A. Remelé³ has made the type of his subgenus *Palæoclymenia*, which he thus defines:—"Whorls overlapping each other at the sides, and consequently forming an umbilicus; higher than wide. Shell provided with strong spiral striæ, with lines of growth crossing them."

Now the principal character upon which this subgenus is founded, and by which it is separated from *Paleonautilus*, Remelé (type *Trocholites planorbiformis*, Hall—non Conrad), is the alleged superiority of the *height* of the volutions to their *width*, as affirmed by Conrad in his description of *T. planorbiformis*. But we have seen that Conrad described *Trocholites* as having a "lunate aperture," which could not be the case if the whorls were "higher than wide"; i. e., if the dorso-ventral diameter of the section of the whorl exceeded the transverse. In whatever way this contradiction in the terms of Conrad's description of his genus may have arisen⁴, it misled Remelé into supposing that the *Trocholites planorbiformis* of Conrad and Hall's *T. planorbiformis* were distinct, and belonged even to different subgenera of *Trocholites*, an assumption for which there is no ground whatever. Hall expressly mentions in his descrip-

¹ Proc. Boston Soc. Nat. Hist. 1883, vol. xxii. p. 260. See also Part I. of the present Catalogue, Introd. p. v.

² Journ. Acad. Nat. Sci. Philadelphia, 1842, vol. viii. pt. ii. p. 274.

³ Zeitschr. der Deutsch. geol. Gesell. 1881, Band xxxiii. Heft i. p. 1.

⁴ One can hardly avoid the suspicion that Conrad described *Trocholites* as a Gasteropod, for he places it among genera belonging to that class, such as *Loxonema*, *Platystoma*, &c.

tion of *Trocholites planorbiformis* that he had examined Conrad's original specimen in the cabinet of the Academy of Natural Sciences at Philadelphia, before coming to the conclusion that his specimens were identical with Conrad's. Conrad gives no figure of the section of the whorls of his species by which the relations of the two diameters could be seen; but his figure of the shell (viewed laterally) is excellent in all respects, and it differs in no way (except perhaps that the umbilicus is a little deeper) from Hall's figure (Pal. New York, vol. i. pl. lxxxiv. fig. 3 a). It should be added that both Hall's and Conrad's specimens, here spoken of, came from precisely the same locality, viz. near Grimbsy, Canada West, and were collected by the same individual, a Mr. Ashmead of Philadelphia.

***Trocholites undosus*, J. de C. Sowerby, sp.**

1839. *Nautilus undosus*, J. de C. Sowerby, in Murchison's 'Sil. Syst.' pt. ii. p. 642, pl. xxii. f. 17.
 1848. *Lituities undosus*, Salter, Mem. Geol. Surv. vol. ii. pt. i. p. 352.
 1849. *Lituities undosus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 1.
 1852. *Trocholites anguiformis*, M'Coy, British Pal. Foss. fasc. ii. p. 323, pl. i. L. f. 26.
 1854. *Lituities angulatus*, Saemann, Ueber die Nautiliden, in Palæontographica, Band iii. p. 166, tab. xxi. ff. 1 a-d.
 1855. *Lituities anguiformis*, Salter, in Sedgwick & M'Coy's British Pal. Foss., Appendix A, p. viii, pl. i. L. f. 26.
 1860. *Clymenia rarospira* (pars), Eichwald, Lethæa Rossica, vol. i. Seconde Section de l'ancienne Période, p. 1302, pl. L. ff. 1 a, b, & 3 a-c; not ff. 2 a, b, 6 a-c.
 1861. *Lituities antiquissimus*, Ferd. Roemer, Die Fossile Fauna der Silurischen Diluvial-Geschiebe von Sadewitz, p. 62, Taf. vi. ff. 2, b, c, d, e; not ff. 2 a, f, g. (Not *Clymenia antiquissima*, Eichw.)
 1879. *Lituities undosus*, Kjerulf, Udsigt over det sydlige Norges geologi, Atlas, pl. xvi.
 1880. *Discoceras convolvens*, Angelin & Lindström, Fragmenta Silurica, p. 10, tab. xvi. f. 3. (Not *Lituities convolvens*, Hisinger.)
 1880. *Lituities undosus*, Kjerulf & Gurlt, Die Geologie des südlich. und mittl. Norwegen, p. 68.
 1882. *Trochoceras undosum*, Blake, British Foss. Ceph. pt. i. p. 226, pl. xxx. ff. 5, 5 a; not f. 6.
 1882. *Nautilus (Trocholites) anguiformis*, Blake, ibid. p. 213, pl. xxviii. ff. 2, 2 a.
 1883. *Trocholites angulatus*, Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 267.

Sp. Char. Shell discoid, consisting of 3 or 4 volutions, which are all visible; each whorl is slightly indented on the concave side,

where the preceding one comes in contact with it. The body-chamber in the type specimen occupies $\frac{1}{3}$ of a whorl. The section is distinctly quadrangular, the convex side being broader than the concave. The septa are rather numerous, their distance upon the sides of the shell being about 3 lines where the diameter is about 1 inch. The sutures form a broad and shallow sinus on the sides, and bend sharply forwards upon the lateral angles, making a broad and shallow sinus again on the convex side. The siphuncle is situated close to the concave border of the shell. The first whorl is ornamented with fine and regular transverse raised lines, 5 or 6 in the space of 1 line. At a later stage these give place to irregular lines of growth, which at intervals of 1 to $1\frac{1}{2}$ lines assume the character of riblets, becoming stronger upon the periphery, where in adult shells they almost pass into ribs. The whole of the test, which is very thick, and composed of several layers, is covered with fine transverse lines of growth. Owing to weathering, and in some cases to changes brought about by fossilization, the surface of the test sometimes assumes a very different character from that which it presents when well preserved. Some of the figures, for example (notably Roemer, *loc. cit.* pl. vi. f. 2 b), represent the lines of growth as minutely waved: but this appearance, judging by specimens I have examined, is due merely to the exfoliation of the edges of the laminæ of the test.

Remarks. The type specimen of *Trocholites undosus* (preserved in the Museum of the Geological Society) is much crushed and distorted, so that many of the septa (except those near the body-chamber) are closer together than they would naturally be. Those near the body-chamber are 2 lines apart. The sutures are strongly bent forwards at the lateral angles. The whorls have the subquadrate section characteristic of the Norwegian specimens in the British Museum Collection, and as figured in the works cited above. There are some very obscure and irregular prominences on the type specimen, which appear to be due simply to unequal erosion of the surface of the cast, and are not of the nature of ribs as represented in Sowerby's figure, in which they have been considerably intensified.

Horizon. Étages 4 and 5 α (Bala Series).

Localities. Porsgrund, Klosterfos Waterfall near Skien, Sandviken near Christiania, Herø (Hardanger Fjord): Norway.

Represented in the Collection by several very fine specimens, some of which were transferred from the Museum of Practical Geology.

Trocholites ammonius, Conrad.

1838. *Trocholites ammonius*, Conrad, Ann. Geol. Report, p. 119.
 1842. *Trocholites ammonius*, Emmons, Geology of New York, pt. ii. p. 279, f. 3; p. 392, f. 1.
 1842. *Trocholites*, *Utica trocholite*, Vanuxem, Geology of New York, pt. iii. p. 57, f. 3.
 1847. *Trocholites ammonius*, Hall, Palæontology of New York, vol. i. p. 192, pl. xl. A. ff. 4 a-k; *ibid.* p. 309, pl. lxxxiv. ff. 2 a-c.
 1888. *Trocholites ammonius*, Ami, Canadian Record of Science, vol. iii. No. 2, p. 105.

Sp. Char. "Discoidal; volutions in the same plane, about four, rounded, slightly concave on the ventral side, gradually enlarging in size towards the aperture, which is slightly expanded; surface marked by lamellose, irregular and oblique transverse striæ or ridges, between and upon which are finer lamellose striæ, covering the outer surface, and giving it a peculiar textural or netted appearance; striæ meeting in an arch upon the back; septa direct, or slightly undulated on the dorsal [convex] side: outer chamber [body-chamber] large; siphuncle ventral [internal]. . . . The peculiar character of the surface is produced by the numerous crowded edges of lamellæ, which, in perfect specimens, are somewhat regularly undulating. When the shell is partially exfoliated, the textural character of the surface is destroyed, and it is only marked by fine oblique striæ. The stronger striæ are very variable, being sometimes so prominent as to deserve the name of ridges, and at other times are only slight undulations; while in many instances they are not at all developed, and the surface is marked only by the finer lamellose striæ." (*Hall.*)

Remarks. Professor Hall states regarding the horizon of this species that it "occupies a central position in the Trenton limestone, being unknown in the lower part, but passing upwards into the Utica slate, where it is of less frequent occurrence." Mr. H. M. Ami records it from Murray Bay (Province of Quebec), and Whitby, Ottawa, and Collingwood (Province of Ontario), Canada, in the Utica shales. It does not appear to have been found above this horizon. Mr. J. F. Whiteaves¹ notes the occurrence in the Guelph Formation (Silurian) of *Trocholites multicostatus*, Whitfield, which he considers "very closely allied" to *T. ammonius*.

Horizon. Trenton Limestone (= Llandeilo).

Locality. Middleville (Herkimer Co.), New York State.

Represented in the Collection by two examples, presented by J. E. Lee, Esq., F.S.A., F.G.S.

¹ Palæozoic Fossils (Geol. & Nat. Hist. Surv. Canada), vol. iii. pt. i. p. 36, pl. vi. ff. 1, 1 a.

Trocholites planorbiformis, Conrad.

1842. *Trocholites planorbiformis*, Conrad, Journ. Acad. Nat. Sci. Philadelphia, vol. viii. pt. ii. p. 274, pl. xvii. f. 1.

1847. *Trocholites planorbiformis*, Hall, Palæontology of New York, vol. i. p. 310, pl. lxxxiv. ff. 3 a-f.

Sp. Char. "Depressed, orbicular, or planorbiform; volutions about four or five, wider than deep [*i. e.* the transverse greater than the ventro-dorsal diameter]; apex profoundly and equally depressed on both sides; aperture lunate; section elliptical, with the inner side concave from the junction of the next volution: surface marked by obliquely transverse ridges, which bend backwards, forming a broad curve [sinus] on the dorsal [convex] line [? side], longitudinally striated with rounded lines.

"In all the specimens examined, the outer lamina of the shell is exfoliated, and the fine striæ of the surface are destroyed. The character of the shell is much like that of *T. ammonius*, and I have been disposed to regard it as a variety of the same. But in specimens of that species from the Trenton limestone I have rarely found the transverse and longitudinal ridges so strongly marked as in this specimen. The shell is always larger than the specimens of the Trenton limestone, but in other respects there are few important differences. . . . " (*Hall.*)

Remarks. The young in the Canadian examples of this species are ornamented with very distinct, but somewhat irregular, transverse annulations, which form a tolerably deep sinus upon the convex side of the shell. These ornaments become almost obsolete in the adult shell, though they sometimes reappear for a short distance; they are accompanied by fine lines of growth. Crossing the latter, and running longitudinally for the whole length of the shell, are a series of very fine lines which form a minute network with the lines of growth. Two or three of the longitudinal lines, along the median line of the periphery, are stronger than the rest.

Though there can be very little doubt as to the generic position of the fossil ascribed by Salter to the present species (*Mem. Geol. Surv.* 1866, vol. iii. p. 358, pl. xxv. f. 5), the fact that he describes the whorls as *smooth*, whereas in the American species they are ribbed, would be sufficient to distinguish the British species from the latter.

The specimen figured by Blake (*British Foss. Ceph.* pt. i. pl. xxix. ff. 8, 8 a) shows a different style of ornamentation from that of the American examples above described, the ribs in the British specimen being much sharper, stronger, and wider apart than they are in the latter. Salter's type of *Lituites Hibernicus* is a cast only.

I append here references to the British fossils which have been referred by different authors to *Trocholites planorbiformis* :—

1845. *Nautilus primævus*, Salter, Quart. Journ. Geol. Soc. vol. i. p. 20.

1852. *Trocholites planorbiformis*, M'Coy, British Pal. Foss. fasc. ii. p. 324.

1852. *Lituities planorbiformis*, Salter, *ibid.* Appendix A, p. vii.

1852. *Lituities Hibernicus*, Salter, British Assoc. Rep. p. 61.

1866. *Lituities planorbiformis*, Salter, Mem. Geol. Surv. vol. iii. p. 358, pl. xxv. f. 5.

1873. *Lituities planorbiformis*, Salter, Cat. Cambr. & Silur. Foss. p. 71.

1882. *Nautilus (Trocholites) planorbiformis*, Blake, British Foss. Ceph. pt. i. p. 213, pl. xxix. ff. 8, 8 a, 9, 9 a.

Horizon. Trenton Limestone (= Llandeilo).

Localities. Montmorenci and Lorette, near Quebec, Canada ; Middleville (Herkimer Co.), New York State.

Well represented in the Collection. The Canadian specimens were presented by Dr. J. J. Bigsby, F.R.S.

***Trocholites Scoticus* ?, Blake, sp.**

1882. *Nautilus (Trocholites) Scoticus*, Blake, British Foss. Ceph. pt. i. p. 215, pl. xxviii. f. 4, pl. xxix. f. 6.

Sp. Char. The following is Professor Blake's description of the type specimen :—" Rate of increase 1·45. Last whorl ·37 ; the outer whorls slightly overlapping. The specimen is contorted, and thus appears out of symmetry. The section is a nearly uniform ellipse, with axes in the ratio of 10 : 9, and the long diameter in the plane of curvature. There are no ribs of large size, but the whole is uniformly covered with sharp riblets, which pass obliquely backwards and meet at a rounded angle of 60° on the front. There are about three of these per line in the middle of the whorl. The body-chamber leaves the coiled portion for a short distance, and the shell is thickened near the aperture, which is parallel to the riblets : thus it is oblique, and has a deep concavity on the front, and then the shell expands. No septal characters are ascertainable, though septa are present."

In another specimen Professor Blake found that there were 22 septa in a whorl.

Remarks. This species differs from *Trochoceras* ["*Lituities*"] *cornuarietis* in the absence of annulations.

The specimen which I have referred to the present species is very much crushed, and is altogether in an exceedingly imperfect condition, but it has the ornaments described in Blake's species, and is

apparently a shell of the character he describes, so that I have ventured to place it in the same category.

Horizon. Llandeilo.

Locality. Near Builth, Radnorshire.

Represented in the Collection by a single example.

Trocholites Odini, Eichwald, sp.

1840. *Clymenia Odini*, Eichwald, Schichtensyst. v. Esthland, p. 107.

1858. *Lituities Odini*, Schmidt, Archiv für die Naturkunde Liv-, Ehst- und Kurlands, p. 198.

1860. *Clymenia Odini*, Eichwald, Lethæa Rossica, vol. i. Seconde Section de l'ancienne Période, p. 1304, pl. li. ff. 27 a, b.

1860. *Lituities Odini*, Lossen, Zeitschr. der Deutsch. geol. Gesell. Band xii. p. 23.

1881. *Trocholites (Palæonutilus) Odini*, Remelé, Zeitschr. der Deutsch. geol. Gesell. Band xxxiii. Heft i., "Zur Gattung *Palæonutilus*," p. 13.

[Not 1845. *Lituities Odini*, de Verneuil, in Murchison, de Verneuil, and de Keyserling's Geol. de la Russie d'Europe, vol. ii. pt. iii. p. 360, pl. xxv. ff. 8 a-c.]

Sp. Char. Shell small, discoid; whorls depressed, slightly embracing, increasing slowly in diameter, the concave side abruptly emarginate by contact with the convex side. The siphuncle is situated on the concave margin. The transverse section is almost semilunate, *i. e.* considerably wider than high, the two diameters being in the ratio of $5\frac{1}{2}$ to 7. The septa are approximate, being about $1\frac{1}{4}$ lines distant where the ventro-dorsal diameter is $5\frac{1}{2}$ lines. The surface of the test is ornamented with fine, equal, close-set, oblique, transverse striæ, which in the young shell (first whorl) are stronger than in the adult. These ornaments form a small backwardly directed sinus upon the periphery. They are distinctly visible to the naked eye.

Remarks. The *Lituities Odini* of de Verneuil is certainly not the same species as Eichwald's *Clymenia Odini*¹. The section in the former is higher than wide, in the latter it is the reverse. The sculpture in Eichwald's species is also coarser than in de Verneuil's,

¹ Eichwald himself observes, under his description of *Lituities teres* (Lethæa Rossica, *loc. cit.* p. 1299), that "the *Lituities teres* [*L. Odini*] figured in the Paléont. de Russie (p. 360, pl. xxv. f. 8) is not the *Clymenia Odini*, mihi, which does not even belong to *Lituities* and has been confounded with the *Lituities teres* described by me in 1840, in my rock-systems of Esthonia [Schichtensyst. von Esthland, St. Pétersb. p. 105]. I have here restored to it its correct name [*Lituities teres*]."

and, finally, the last whorl in the latter is separated from the rest, and this gives it, added to its other characters, quite the aspect of a *Lituïtes*, to which genus de Verneuil referred it.

Horizon. Étage 5 a (Bala Series¹).

Locality. Herö, Norway.

Represented in the Collection by a single imperfect example.

Trocholites ? falcigerus, Eichwald, sp.

1857. *Cyrtoceras falcigerum*, Eichwald, Bull. de la Soc. des Naturalistes de Moscou, p. 184.

1860. *Cyrtoceras falcigerum*, Eichwald, Lethæa Rossica, vol. i. Seconde Section de l'ancienne Période, p. 1287, tab. xlvii. ff. 6 a, b.

Sp. Char. Shell of medium size, a little compressed at the sides, and strongly curved, slowly increasing in diameter; ornamented with large, distant, oblique, acute annulations, wider apart on the periphery, where they form a small and rather deep sinus, the interspaces showing only obscure lines of growth. The transverse section is elliptical in the type specimen, which is a fragment measuring 1 inch 9 lines in length, the greatest dorso-ventral diameter being 10 lines, the least 7 lines.

Remarks. The specimen in the British-Museum Collection representing this species is a fragment consisting of a portion of two volutions. It has at first sight the aspect of a *Trochoceras*, but the internal position of the siphuncle excludes it from that genus. Its affinities cannot be certainly determined without better material.

Horizon. *Orthoceras*-Limestone (= Arenig).

Locality. Esthonia, Russia.

Represented in the Collection by a single example.

Trocholites antiquissimus, Eichwald, sp.

1840. *Clymenia antiquissima*, Eichwald, Schichtensyst. von Esthland, p. 115.

1842. *Clymenia antiquissima*, Eichwald, Die Urwelt Russlands, Heft ii. p. 33, tab. iii. ff. 16, 17.

1845. *Clymenia antiquissima*, de Verneuil, in Murchison, de Verneuil, and de Keyserling's Géol. de la Russie d'Europe, vol. ii. pt. iii. p. 361.

1849. *Trocholites antiquissimus*, d'Orbigny, Prodr. de Paléont. vol. i. p. 5.

¹ For correlations of Scandinavian and British rocks see Kjerulf, Veiviser ved geol. excurs. i Christiania omegn. (1865); Murchison, 'Siluria,' 5th ed., chap. xiv. (1872); J. E. Marr, Quart. Journ. Geol. Soc., Aug. 1882, p. 313.

1858. *Lituites (Trocholithus) antiquissimus*, Schmidt, Archiv für die Naturkunde, Liv-, Ehst- und Kurlands, p. 198.

? 1860. *Clymenia rarospira*, Eichwald, Lethæa Rossica, vol. i. Seconde Section de l'ancienne Période, p. 1302, tab. I. ff. 2 a, b; 6 a-c, not ff. 1, 3.

1867. *Discoceras antiquissimum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 177.

[Not 1861. *Lituites antiquissimus*, Roemer, Die Fossile Fauna der Silurischen Diluvial-Geschiebe von Sadewitz, p. 62, Taf. vi. ff. 2 a-g.]

Sp. Char. Shell of large size, umbilicated on both sides, with five closely contiguous volutions, the body-chamber deeply emarginate on the convex side. The section is rather obscurely subquadrate. The septa are numerous, their distance apart on the sides of the shell being about 3 lines where the shell-diameter is 13 or 14 lines; the sutures form a shallow sinus on each side and a distinct lobe at the superior lateral angles. The siphuncle is situated close to the concave border of the shell. The ornaments of the test consist of prominent, oblique, widely separated annulations, which do not, however, leave any mark upon the cast; they form a shallow backwardly-directed sinus upon the periphery. The annulations and their interspaces are covered with very fine and close-set imbricating lines.

Remarks. To this species I have referred an example which has some of the test remaining, in which the ribbing is obscurely traceable, while the finer ornaments are well preserved in one or two places. The character of the septation is well seen, and it agrees perfectly with that of Eichwald's species.

Horizon. *Orthoceras*-Limestone (= Arenig).

Locality. Ozersky (?) (Esthonia), Russia.

Represented in the Collection by a single example.

***Trocholites iuliformis*, Salter, sp.**

1865. *Lituites iuliformis*, Salter, in Palæont. of Niti in the Northern Himalaya, being Descriptions and Figures by J. W. Salter and H. F. Blanford of the Palæozoic and Secondary Fossils collected by Colonel R. Strachey, R.E., p. 14, pl. ii. f. 2.

Sp. Char. "Discoid, and very much flattened; our solitary specimen an inch and three quarters in diameter, having at least four or five contiguous but not embracing whorls, which are squarish in section, about two thirds as deep from back to front as wide; somewhat flattened on the sides, sloping to the umbilical margin, very blunt and flat on the back, and gently concave on the inner edge. Surface with undulating sharp unequal striæ of growth. The

siphuncle is quite internal, almost touching the inner border. Septa rather distant, in whorls 5 lines deep, nearly 2 lines apart, not very convex, moderately arched backwards on the sides, and straight, or only gently curved across the back.

"This species puts one in mind greatly of the *L. (Trocholites) ammonius* of Conrad, a Lower Silurian species from North America, and belongs to the same division of the genus. It differs in being much less compressed from back to front." (Salter.)

Remarks. The "Cephalopoda" [of Niti] says Salter (*loc. cit.* p. 12), "remind us, by their general characters, of those of other Silurian regions. This may certainly be said of the species of the genus *Orthoceras*. The *O. Kemas* is exactly like a common Ludlow Rock fossil. The species of *Lituites* can scarcely be otherwise than from the same Silurian group. . . ."

Horizon. Silurian?

Locality. Chorhoti Pass (18,200 feet), Himalaya Mountains.

Genus **GYROCERAS**, de Koninck¹.

[*Gyroceratites*, von Meyer, 1831²; *Spirula*, Goldfuss, 1832³; *Hortolus*, Steininger, 1834⁴; *Spirulites*, Quenstedt, 1836⁵; *Spirula*, Bronn, 1837⁶; *Cyrtoceras*, Phillips, 1841⁷; *Cyrtoceratites*, d'Archiac and de Verneuil, 1842⁸; *Conularia*, Fischer, 1848⁹; *Nautiloceras*, *Aploceras*, d'Orbigny, 1849¹⁰; *Halloceras*, *Kophinoceras* (pars), *Apsidoceras*?, *Triboloceras* (pars), Hyatt, 1883¹¹.]

Spec. Char. Shell forming a single whorl, or several whorls, coiled upon the same plane, just touching, or completely out of contact. Transverse section subcircular, transversely elliptical or subtriangular. Body-chamber of moderate size, generally occupying about one-third of the last whorl, though this proportion is exceeded in some Carboniferous species. Aperture simple, emarginate on the ventral or

¹ Descrip. des Anim. Foss. du Terr. Carb. de la Belgique, 1844, p. 530.

² Nova Acta Acad. Leop.-Carol. vol. xv. pt. ii. p. 73.

³ In von Dechen's Handb. der Geognosie von H. de la Beche, p. 536.

⁴ Mém. de la Soc. Géol. de France, vol. i. pt. ii. p. 370.

⁵ De notis Nautillearum primariis, p. 24.

⁶ Lethæa Geognostica, Band i. p. 102.

⁷ Pal. Foss. of Cornwall, Devon, and West Somerset, p. 115.

⁸ Trans. Geol. Soc. ser. 2, vol. vi. p. 349.

⁹ Bull. Soc. Imp. des Nat. de Moscou, vol. xxi. p. 6.

¹⁰ Prodr. de Paléont. Stratigr. vol. i. p. 112.

¹¹ Proc. Boston Soc. Nat. Hist. vol. xxii. pp. 284-294.

convex side. Septa numerous; sutures simple. Siphuncle cylindrical, usually near the convex border of the shell, or between that and the centre; rarely near the concave border, as in *G. expansum*, Saemann. The test is ornamented with lines of growth, or, in addition to these, with regularly arranged, strong, tubercular folds (Silurian and Devonian species); or with numerous longitudinal ridges, studded with small tubercles (Carboniferous species).—Silurian to Carboniferous¹.

Remarks. The history of this genus may be briefly sketched as follows:—James de Carle Sowerby was the first to describe a species belonging to the genus *Gyroceras* under the name of "*Orthocera paradoxica*" (placed in this work in the subgenus *Trigonoceras*). Sowerby, though suspecting that he was dealing with a new generic type, was too cautious to institute a new genus for the reception of the strange form he was describing. His observations upon its affinities are interesting, and as they are not lengthy I here transcribe them:—

"It would perhaps have been proper to constitute a new genus of this very remarkable fossil, to be placed between *Nautilus* and *Orthocera*, but experience has shown us how dangerous it is to form genera from such characters as fossils possess, especially when fragments only are preserved and we have not the whole tribe before us. We know of only a short portion of the shell before us; one end of it is but half as wide as the other, and the curvature not more than the sixth part of a circle; therefore if it be an involute shell, the inner whorls must be very slender, or the outer one must have receded from them with a much less degree of curvature than they possess. The genus *Spirula* is perhaps the nearest approach among recent shells to such a form as this fossil might possibly have had when perfect; in the present state of our knowledge of its form, however, it would seem to be a rather bold assertion to declare them of the same genus."

In 1829 Hermann von Meyer described some fossil fragments under the name of *Gyroceratites gracilis*², which consisted of portions

¹ Some authors have cited this genus as originating in the Ordovician Period, but this is probably a mistake. It is true that Billings (Report of Progress, Geol. Surv. of Canada, for the years 1853–56 (1857), p. 307) described a species from the Ordovician of the island of Anticosti under the name of "*Gyroceras (Lituities) magnificum*"; but his specimens were in such a bad state of preservation that they failed to show all the generic characters of *Gyroceras*, and might have belonged to *Lituities* or to *Trochoceras*.

² Nova Acta Acad. Leop.-Carol. vol. xv. pt. ii. p. 73.

of two species of a *Goniatites*¹. The inner whorls being broken away, the shell appeared to have separated whorls. The genus *Gyroceras* was thus based upon an accident in no way connected with the structure of the shell, and a name thus bestowed must inevitably have lapsed if it had not been applied to other species of fossil Cephalopods to which it was appropriate. Accordingly we find the genus *Gyroceras* taken in hand by de Koninck in 1844, and again in 1880, and restricted to such forms as could be differentiated from allied genera.

SILURIAN SPECIES.

Gyroceras alatum, Barrande.

1848. *Gyroceras alatum*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, Band iv. p. 208.
 1852. *Gyroceras alatum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 196.
 1867. *Gyroceras alatum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 162, pl. xlv. ff. 8-18, pl. ciii. ff. 15-20, pl. cccclxv. ff. 10-12, pl. cccclxxvi. case ix.
 1876. *Gyroceras alatum*, Ferd. Roemer, Lethæa Geognostica (Leth. Palæozoica, Theil i.), Atlas, Taf. xv. f. 4.
 1883. *Hercoceras alatum*, Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 283.

Sp. Char. Shell coiled, and usually forming three nearly complete whorls, which have a central vacuity, as in many Palæozoic Nautilidæ. The whorls are never in contact, but the degree of the separation varies in different individuals, and it is greater in the region of the body-chamber. The curvature is, however, always maintained in *Gyroceras*, and thus contrasts with the straight termination of the shell in *Lituites*. The transverse section in the present species is elliptical, in which the transverse is to the ventro-dorsal axis as 4:3, and sometimes as 5:4. The increase in diameter is in the ratio of 1:3, in the length of the last whorl. The body-chamber occupies about half the outer whorl. The aperture has a shallow sinus in the centre of the convex border, and on each side there is a considerable lamellar expansion of the test forming wing-like projections, which are often an inch in length, hence the name *alatum*. The traces of these expansions are seen upon the shell at pretty regular intervals, marking successive lips, and forming a characteristic feature in its ornamentation. The distance between

¹ This was afterwards described as *Goniatites compressus* by Beyrich and other authors; but Giebel (Fauna der Vorwelt, Band iii. Abth. i. p. 481) restored to it its first specific name—*Goniatites gracilis*.

the septa attains a maximum of about one fifth of the ventro-dorsal diameter. The siphuncle is situated close to the convex border. The ornaments of the test consist of fine subregular striæ of growth, which form a distinct sinus upon the convex border, the lateral wing-like expansions leaving also their mark upon the sides of the shell in the shape of a very distinct imbrication in the outer layer of the test.

Remarks. This species is distinguished from all its congeners by its remarkable ornaments.

Horizon. Étage F (=Downtonian).

Localities. Konieprus, Mnienian, Bohemia.

Well represented in the Collection by numerous specimens, one of which was presented by J. E. Lee, Esq., F.G.S.

DEVONIAN SPECIES.

Gyroceras ornatum, d'Archiac & de Verneuil, sp.

1832. *Spirula nodosa*, Goldfuss, in von Dechen's Handb. der Geognosie von H. T. de la Beche, p. 536.
1832. *Cyrtocera ornata*, Goldfuss, *ibid.*
1833. *Hortolus convolvans*, Steininger, Mém. de la Soc. Géol. de France, vol. i. pt. i. p. 370, pl. xxiii. ff. 3, 3 a.
1837. *Spirula nodosa*, Bronn, Lethæa Geognostica, Zweite Aufl. Band i. p. 102, Taf. i. ff. 4, a, b.
- ? 1841. *Cyrtoceras nodosum*, Phillips, Pal. Foss. of Cornwall, Devon, and West Somerset, p. 116, pl. xlv. f. 221. (Perhaps not of Goldfuss.)
1841. *Cyrtoceras* (?) *bdellalites*, Phillips, *ibid.* p. 117, pl. xlvii. ff. 223, a, b.
1842. *Cyrtoceratites ornatus*, d'Archiac and de Verneuil (Goldfuss, Bonn Museum), Trans. Geol. Soc. 2nd ser. vol. vi. pt. ii. p. 349, pl. xxviii. ff. 5, 5 a, 5 b.
1849. *Spirulites nodosus*, Quenstedt, Petrefactenkunde Deutschl., Band i. Abth. i. p. 48, tab. ii. ff. 10, a, b.
1849. *Gyroceras convolvans*, d'Orbigny, Prodr. de Paléont. vol. i. p. 52.
1849. *Gyroceras Goldfussi*, D'Orbigny, *ibid.*
1852. *Gyroceras nodosum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 195.
1856. *Gyroceras ornatum*, G. & F. Sandberger, Die Verstein. Nassau, p. 137, Taf. xiii. ff. 1, 1 a, 1 b, 1 c.
1876. *Gyroceras nodosum*, Ferd. Roemer, Lethæa Geognostica (Leth. Palæozoica, Theil i.), Atlas, Taf. xxx. ff. 2 a, 2 b.
1883. *Kophinoceras ornatum*, Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 285.

Sp. Char. Shell coiled and forming at least one volution and a half; depressed vertically, so that the section is transversely elliptical, the ratio of the two diameters, augmenting gradually with age, is 24:32 in an adult specimen. A ridge, more prominent in adult than in young shells, is formed along the median line of the periphery. The sides are subangular, and have a waved outline imparted to them by the projection of the prominent nodes which ornament the surface of the shell and strongly mark even the cast. Septa moderately distant from each other, being 5 lines apart where the longer diameter of the shell is nearly $2\frac{1}{2}$ inches; arching forward upon the periphery and forming a shallow sinus on either side of it, again inclining slightly forward at the lateral angles, and thence pursuing a straight course upon the concave aspect of the shell. The increase in diameter is in the ratio of 1 to $2\frac{1}{4}$ in a complete volution. The siphuncle is situated close to the convex border of the shell, in the median line of the periphery; it is cylindrical and of moderate size; and sometimes contains radiating deposits. The ornaments of the test are very prominent: taking first those of the convex or outer aspect of the shell, they consist of nine or ten longitudinal ridges crossed by numerous fine and close-set imbricating striæ, which give rise to slight nodes in crossing the ridges. In addition to these this region of the shell is furnished with "three longitudinal rows of elevated tubercles, which are geminated or united together in pairs. The tubercles of the median row are placed a little behind those of the lateral rows, they are also less elevated, a little elongated, and arranged in a zigzag direction. In each pair placed on the side [the lateral angle], the tubercle which occupies the lateral keel is larger and more prominent than that of the back, to which it is joined by a sort of pinching up of the shell" (*d'Archiac & de Vernueil*). The tubercles are thus produced by the crossing of the longitudinal and transverse ornaments. The large lateral tubercles or folds, which occur at pretty regular intervals (of about 1 inch), doubtless mark the position of successive apertures of the shell. The concave surface of the shell is ornamented only with faint longitudinal ridges, crossed by the fine imbricating striæ already described. The body-chamber in this species has not been seen.

Remarks. Among the many figures given of this species, representing it in various stages of growth and in different conditions of preservation, those of *d'Archiac* and *de Vernueil*, and of *G. and F. Sandberger* illustrate its characters most faithfully. It is difficult, without examining the original specimen, to estimate rightly the value of the claim put forward for regarding the *Spirula nodosa* of

Goldfuss (Bonn Museum) as distinct from the species just described. The figures of *G. nodosum* given by Steininger, Bronn, and Roemer represent immature shells, but, such as they are, they appear to me to present no characters to warrant their separation from *G. ornatum*, and I have therefore included *G. nodosum* in the synonymy of that species.

Regarding Phillips's recognition of *G. ornatum* among his South Devon fossils, it may suffice to say that the condition of his specimens is too imperfect to warrant any conclusion as to their specific affinities. Of two of them, now in the British Museum, the one referred to *G. nodosum* by Phillips (under the name of *Cyrtoceras nodosum*) is much too imperfect for identification; while the other is referred by the same author to *G. ornatum* (*Cyrtoceras ornatum* (?)) with doubt, owing to the fact that the specimens were "not sufficient to allow of strict comparison."

It will be of interest to note that from a specimen which has lately come into the possession of the Museum (forming part of the Lee gift), the identity of Phillips's "*Cyrtoceras* (?) *bdellalites*" with *G. ornatum* can now be demonstrated. Phillips affirms respecting this species, that "in some specimens displacements appear; in others irregular bending and distortion, such as may naturally be expected in rocks so much disturbed by violent pressures and rearrangements as those of North and South Devon." It cannot be surprising therefore that fossils from this region should present such difficulties to the palæontologist who attempts to identify them.

It may be added that *Gyroceras Medlicottianum*, Waagen¹, is not unlike the present species, but it has a row of small tubercles on the inner side of the whorl, just below the lateral angles. It is a fragment only.

Horizon. Middle Devonian.

Localities. *British.* Mudstone Bay, near Torquay, Newton Bushel, Tor Abbey (Tor Bay), Devonshire.—*Foreign.* Gerolstein, Eifel; Nismes, Belgium.

Represented in the Collection by a large and fine series of specimens, several of which were presented by J. E. Lee, Esq., F.G.S., one of whose specimens was figured by Phillips in his 'Palæozoic Fossils of Cornwall, &c.' (p. 116, pl. xlv. f. 221) under the name of "*Cyrtoceras nodosum*." The Collection contains also two other specimens (No. C. 1574) figured and described by Phillips in the same work, under the name of "*Cyrtoceras* (?) *bdellalites*."

¹ Palæont. Indica, ser. xiii. Salt-Range Fossils, i. p. 65, pl. vi. ff. 6, a-c.

Gyroceras Eifelense, d'Archiac and de Verneuil, sp.

1832. *Spirula costata*, Goldfuss (Bonn Museum), in von Dechen's Handb. der Geognosie von H. T. de la Beche, p. 536 (*vide* G. & F. Sandberger).
- ? 1841. *Cyrtoceras nautiloideum*, Phillips, Pal. Foss. of Cornwall, Devon and West Somerset, p. 116, pl. xlv. f. 220.
1842. *Cyrtoceratites Eifelensis*, d'Archiac & de Verneuil, Trans. Geol. Soc. 2nd ser. vol. vi. pt. ii. p. 349, pl. xxxi. ff. 2, 2 *a*, 2 *b*.
1849. *Spirula Eifeliensis*, Quenstedt, Petrefactenkunde Deutschl. Band i. Abth. i. p. 49.
1849. *Gyroceras nautiloideus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 52.
1849. *Gyroceras Eifelensis*, d'Orbigny, *ibid*.
1852. *Gyroceras Eifelense*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 193.
1856. *Gyroceras costatum*, G. & F. Sandberger, Die Verstein. Nassau, p. 136, Taf. xii. ff. 5 *a* to 5 *d* (fig. 5 *a* is copied from d'Archiac and de Verneuil).

Sp. Char. Shell coiled, forming at least one volution and a half, depressed vertically and increasing rapidly in diameter. Transverse section elliptical, the ratio of the two diameters being as 22:34 in an example which is a little crushed vertically, so that the lesser diameter is reduced; the ratios of a specimen figured by d'Archiac and de Verneuil (*loc. cit.*) are as 18:27. The septa are rather numerous, being 3 lines apart where the shell has a diameter of about 30 lines; arching slightly forwards upon the periphery, otherwise straight. The increase in diameter is in the ratio of 1 to $2\frac{3}{4}$ in about $\frac{3}{4}$ of a volution. The siphuncle is situated close to the convex border of the shell, in the median line; it is cylindrical and of small dimensions. The ornaments of the test, upon the internal aspect of the shell, consist of "from twelve to fourteen longitudinal folds or threads, with pretty equal spaces. Transverse folds, arched from back to front, with wider spaces than the threads, pass over these latter, and form little tubercles upon them." The external or ventral region of the shell is more ventricose than the dorsal, and is separated from it by two lateral ridges or keels. "On each side of the back [*i. e.* ventral side of the shell] may be reckoned seven rounded folds or threads, more prominent than those of the ventral [*i. e.* dorsal side] region. Transverse folds setting off from the lateral angles, where they join those of the inner part by a very salient tubercular pinching (*pincement*), turn back, forming a very elongated S, and describe upon the middle of the back a sinus whose concavity is turned forward. The passage of these folds over the

longitudinal folds is also marked by a more or less distinct tubercle. The whole shell is covered with fine, close-set, transverse undulated striae, which turn abruptly backward, passing over the back." (*D'Archiac and de Verneuil*.)

Remarks. *G. Eifelense* differs from *G. ornatum* in its more rapid rate of increase and more numerous septa, as well as in the character and disposition of the ornaments of the test; thus the transverse folds in *G. Eifelense* are more close-set and continuous than they are in *G. ornatum*. When the shell is wanting, the other characters I have named will suffice to distinguish the two species.

I have referred the "*Cyrtoceras nautiloideum*" of Phillips to the present species with some doubt, the type specimen being badly preserved, the ornaments having been completely destroyed by mineralization.

Horizon. Middle Devonian.

Localities. *British.* Newton Bushel, Devonshire.—*Foreign.* Gerolstein, Eifel; Petigny, Belgium (?).

Represented by a few imperfect specimens, including the type of Phillips's "*Cyrtoceras nautiloideum*."

Gyroceras Cyclops, Hall.

1861. *Gyroceras Cyclops*, Hall, Descriptions of New Species of Fossils, &c. p. 40.

1862. *Gyroceras Cyclops*, Hall, Fifteenth Reg. Rep. New York State Cab. Nat. Hist. p. 68.

1876. Illustrations of Devonian Fossils: Cephalopoda, pl. liii. ff. 1-3.

1879. *Gyroceras Cyclops*, Hall, Nat. Hist. of New York, Palæont. vol. v. pt. ii. p. 387, pl. ci., pl. cii., pl. ciii. ff. 1, 2, pl. civ. ff. 1, 2.

Sp. Char. "Shell large, discoidal, regularly coiled. Spiral open, making about one revolution and a half. The revolutions are distant about twenty millim.; near the aperture they are almost contiguous on account of the expansion of the tube. Transverse section sub-circular, or broadly oval, flattened on the dorsum, and obtusely sub-angular on the ventral side. Tube regularly enlarging from the apex. Apical angle about 14° .

"Chamber of habitation small, expanding and forming a campanulate aperture, which opens outward, oblique to the spiral axis of the tube. This feature of the direction of the aperture is inferred from the lines of growth and the direction of the ornamentation of the test. The crenulations are preserved as fine, rounded ridges and striae, along the internal mould of the walls of the air-chambers.

"Air-chambers frequent, regular, becoming numerous towards the apex, having a depth of ten millim. near the grand [body] chamber,

and of one millim. near the apex. Septa smooth, with a very slight concavity, equal to an arc of about 60° . Sutures straight, and at right angles to the spiral axis.

“ Siphuncle near the ventral side, small in its passage through the septa ; having a diameter of six millim. where the tube has a ventro-dorsal diameter of forty-five millim.

“ The test has a thickness of about one millim. on the outer volution. Surface marked by irregular, lamellose, undulating lines of growth, which slope in a retral direction, oblique to the spiral axis of the tube. The ornamentation consists of strong, transverse, prominent, plicate, foliate expansions of the test, inclining towards the aperture, and having an elevation of about twenty-seven millim. on the outer volution, growing less prominent and more finely plicated towards the apex. These expansions are quite regularly plicate, and present surface-marking similar to the general surface of the tube. The folds or plications are continued along the tube, forming rounded, revolving ridges. The sinus in the striæ and ornaments of the test is rounded, and has a width equal to twice the depth. The internal mould is annulated from the strong transverse expansions of the test, and shows the furrows and ridges of the crenulations, with those of the test. Sutures not impressed.

“ One specimen, nearly entire, constituting about one volution and a half, has a length of 600 millim., with a diameter of 75 millim. near the aperture, and measures 210 millim. from the ventral margin of the aperture across the volutions.

“ This species is distinguished by its size, the curvature of the tube, the apical angle, and the prominence of the ornamentation. The apical portion differs from *Gyroceras trivolve*¹ [Conrad, sp.] in its more rapidly enlarging tube and marked characters of the internal mould and surface ornaments. In *G. Nereus* [Hall, *loc. cit.* p. 373, pl. lxi. ff. 4-6] the tube is more slender, less involute, and the expansions of the test are more frequent and more decidedly plicated, but much less elevated. The curvature of the tube in *G. Matheri* [Conrad, sp., Hall, *loc. cit.* p. 377, pl. lv. ff. 1-6] is distinctive, and the tube is more slender, and with a flattened, transverse section. This form [*G. Cyclops*] is a remarkably large and well-defined species, and has a horizontal range greater than any of the previously described forms, except, perhaps, *Cyrtoceras æmulum*² [Hall, *loc. cit.* p. 371].” (*Hall.*)

¹ Hall, Pal. New York, 1879, vol. v. pt. ii. p. 374, pl. lii. ff. 1-6, pl. lii. A. ff. 1-7. See next page.

² This name must be changed, as it has been used by Barrande for a species of *Cyrtoceras* (Syst. Sil. de la Bohême, 1867, vol. ii. pt. i. p. 540).

Remarks. A fairly good specimen of the present species is contained in the British Museum Collection. It is a cast with some fragments of the test adhering to it.

Horizon. Upper Helderberg.

Locality. Columbus, Ohio.

Represented in the Collection by a single example.

Gyroceras trivolve, Conrad, sp.

1840. *Cyrtoceras trivolvis*, Conrad, Geol. Surv. New York; Pal. Dept., Third Ann. Rep. p. 206.

1861. *Gyroceras trivolvis* (Conrad), Hall, Descriptions of New Species of Fossils, &c. p. 37.

1862. *Gyroceras trivolvis* (Conrad), Hall, Fifteenth Reg. Rep. New York State Cab. Nat. Hist. p. 65.

1876. *Gyroceras trivolvis* (Conrad), Hall, Illustrations of Devonian Fossils, Cephalopoda, pl. liv. ff. 1-5, and pl. lvi. f. 4.

1879. *Gyroceras trivolve*, Hall, Nat. Hist. New York, Palæont. vol. v. pt. ii. p. 374, pl. lii. A. ff. 1-7.

Sp. Char. "Shell involute, subdiscoidal, openly coiled. Spiral rapidly enlarging, making from one and a half to two volutions. The last half of the outer volution in large individuals shows a tendency to become straight, and tangent to the spiral. Transverse section subcircular. Tube regularly and gradually enlarging from the apex. Apical angle about 90° .

"The chamber of habitation has a length equal to once and a half the diameter of the tube at the last septum. Crenulations preserved on the internal mould, as low, rounded, longitudinal ridges, with fine intermediate striæ. Aperture straight and horizontal, entire, with a distinct sinus in the ventral margin.

"Air-chambers regular, numerous, having a depth of 4.5 millim. Septa smooth, thin, with a concavity greater than the depth of one air-chamber, or equal to an arc of 110° . Sutures straight, and at right angles to the spiral axis.

"Siphuncle near the ventral side, not expanding in the cavities of the air-chambers.

"The test has a thickness of .75 millim. Surface marked by very fine, undulating, lamellose lines of growth, crossed by revolving striæ and obscure furrows. Tube ornamented with numerous transverse, plicate folds, or expansions of the test, having an elevation of about two millim. on the outer volution, and usually corresponding in frequency with the septa. Sinus distinct, having a width of more than twice the depth.

“From the strength and regularity of the transverse folds of the test, the internal mould is marked by annulations, which are more prominent on the ventrum [convex side]. It also shows lamellose lines of growth, and the furrows and striæ of the crenulations.

“The largest individual observed has a diameter across the disk of 190 millim., with a diameter to the tube of 42 millim. at the aperture.

“This species is distinguished from *Gyroceras Nereus* [Hall, Pal. New York, 1879, vol. v. pt. ii. p. 373] by the greater number of volutions and the character of the surface ornamentation. In *G. citum* [Hall, *loc. cit.* p. 372] and *G. Matheri* [Hall, *loc. cit.* p. 377] the transverse section is different, and the transverse plications are more elevated and distant. The individuals of this species are comparatively common. . . .” (*Hall.*)

Horizon. Upper Helderberg.

Locality. Schoharie, or the Helderberg Mountains¹, New York State. Represented in the Collection by a single example.

CARBONIFEROUS SPECIES.

Gyroceras Luidii, Martin, sp.

1809. *Conch. N. Ammonites (Luidii), anfractibus extrinsecis teretibus* &c., Martin, *Petrificata Derbiensia*, pl. xxxv. ff. 1, 2, and App. p. 16.

1849. *Nautilus Luidii*, d'Orbigny, *Prodr. de Paléont. Stratigr.* vol. i. p. 111.

1855. *Nautilus Luidi*, McCoy, *British Pal. Foss.* fasc. iii. p. 559.

Sp. Char. “Discoid, of two and a half gradually increasing whorls, not embracing [with a moderately large central vacuity]; mouth [section] transversely oval; periphery very broad, convex, sides narrow, rounded, sloping rapidly with slight convexity, to form the wide umbilicus. Entire surface marked with about thirty-six subequal, narrow, thread-like keels, slightly smaller on the sides of the umbilicus, separated by wider, slightly concave, spaces; about five ridges in three lines on middle of body-whorl, at an inch and a half in diameter, closer at smaller size, and fewer in the same space when larger; all the ridges set with small spinulose tubercles,

¹ Buffalo (New York State) is the locality upon the label affixed to the specimen; but this is most probably a mistake, as the species has never been recorded from that place.

about as far from each other as the ridges are apart, and slightly extended transversely so as to form indistinct rows across the whorls, nearly direct on the sides, and with a slight backward wave on the periphery. Septa moderately concave, with nearly simple edges [sutures], having a slight backward wave on the prominent middle of the sides, nearly direct across the periphery. . . . This species seems to be liable to considerable variation in form from pressure, and especially a flattening of the sides, which, however, is certainly not the normal form. I have not seen the siphon, but Martin places it a little within the outer edge." (*M'Coy*.)

Remarks. The dimensions of the type specimen (which is exquisitely preserved) are : greatest diameter 14 lines, breadth of the umbilicus 6 lines. The body-chamber is not known. The apical portion of the shell, which is beautifully preserved in Martin's specimen, is obtusely pointed. M'Coy observes that this species is "not very uncommon in the black beds over the main Carboniferous Limestone of Derbyshire." *Gyroceras tessellatum*, de Koninck (*infra*, p. 67), is a very closely allied species, with similiar form and ornaments ; but the whorls are represented in de Koninck's figure¹ as out of contact from the very commencement, which, if correct, would be sufficient to separate the two forms.

Horizon. Carboniferous Limestone.

Locality. Near Ashford, Derbyshire.

Represented in the Collection by the type specimen figured and described by Martin (*loc. cit.*).

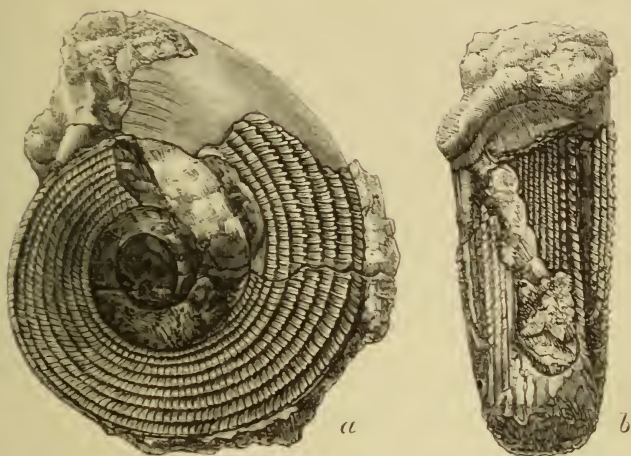
Gyroceras Hibernicum, Foord.

Sp. Char. Shell discoid, composed of two and a half to three whorls with a large central vacuity. The transverse section is sub-quadrangular, the convex side being depressed. The ornaments consist of numerous acute, longitudinal ridges, of which there are nine coarse ones upon the sides, and thirteen or fourteen very fine ones upon the periphery. The ridges are fine and somewhat indistinct at the lower part of the whorls, facing the umbilicus, and become gradually stronger, as well as more distant, till the edge of the periphery is reached, upon the surface of which they are extremely delicate, especially towards the median line. Crossing the ridges are a series of very fine, discontinuous, transverse lines, about six in the space of $\frac{1}{4}$ inch ; these form sharp nodes at their intersection with the ridges, and give a beautiful cancellated

¹ Faune du Calc. Carb. de la Belgique, 1880, pt. ii. pl. xxxiii. ff. 6, 6 a.

appearance to the surface of the test. The septa and siphuncle are not seen.

Fig. 5.



Gyroceras Hibernicum.—*a*, lateral view, showing the ornaments and the initial point of the shell; *b*, front view, showing the fine longitudinal ridges. Drawn from a specimen in the Collection. Natural size.

Remarks. This species is very closely allied to *Gyroceras ornatissimum*, de Koninck, sp., but the sculpture, though of similar character, is much coarser.

Horizon. Carboniferous Limestone.

Locality. Near Dublin.

Represented in the Collection by two examples.

***Gyroceras ornatissimum*, de Koninck, sp.**

1847. *Nautilus Leveilleanus*, d'Orbigny, Paléontologie Universelle, vol. i. pl. lxxxix. ff. 1–4. (Not of de Koninck.)

1849. *Nautilus Leveilleanus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 110. (Not of de Koninck.)

1878. *Nautilus ornatissimus*, de Koninck, Faune du Calc. Carb. de la Belgique, pt. i. (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.) p. 145, pl. xxix. f. 6.

Sp. Char. Shell of medium size, discoid, composed of two and a half to three whorls, the last of which projects beyond the rest for an unknown distance. The whorls increase slowly in diameter, they are all exposed, and there is a large central vacuity. The

transverse section is nearly circular in the young, but becomes subquadrate with rounded angles in the adult, through the flattening of the convex side. The septa are moderately distant from each other (2 lines apart where the ventro-dorsal diameter is 5 lines); the sutures form a shallow sinus upon the sides, bend forwards at the lateral angles, and make another slight sinus in crossing the periphery. There are about twenty-two septa in a complete whorl. The body-chamber is large, and occupies at least half the last whorl. The siphuncle is small and is situated between the centre and the convex border. The test is beautifully ornamented with longitudinal, parallel ridges, which are crossed by strong sigmoid raised lines, which form a series of nodes or small tubercles at their intersection with the ridges. The latter become obsolete upon the last whorl, and only the transverse ornaments are present.

Remarks. This species is easily recognized by the ornamentation and septation, which are well displayed in the specimens in the British Museum which I have referred to it.

Horizon. Carboniferous Limestone.

Locality. Kildare.

Well represented in the Collection.

Gyroceras tessellatum, de Koninck.

1844. *Cyrtoceras tessellatum*, de Koninck, Descr. des Anim. Fossiles du Terr. Carb. de la Belgique, p. 528, pl. xlviii. ff. 5 a, b.

1849. *Aploceras tessellatum*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 112.

1852. *Cyrtoceras tessellatum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 207.

1876. *Cyrtoceras tessellatum*, F. Roemer, Lethæa Palæozoica, pl. xlv. f. 2.

1880. *Gyroceras tessellatum*, de Koninck, Faune du Calc. Carb. de la Belgique, pt. ii. (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. v.) p. 13, pl. xxxiii. ff. 6, 6 a.

Sp. Char. Shell composed of one and a half to two whorls, very distant from each other; the initial point obtuse. The transverse section is broadly subtriangular, except in the apical portion, where it is circular. The first whorl is slightly inflated at regular intervals. The septa are numerous and closely approximate; in a fragment which has a transverse diameter of about 1 inch their distance is only about 1 line; they are regularly concave, shallow, and the sutures are straight. The siphuncle is small and is situated between the centre and the convex border. The surface of the test is ornamented with twenty-three longitudinal ridges, of which about

three upon each side of the shell are much stronger and wider apart than the rest; there are eight of the ridges upon the ventral (convex) surface, which are of medium size, while those upon the dorsal (concave) surface are much finer. All the ridges are covered with discontinuous transverse lines or lamellæ, which form conspicuous nodes where they cross the former.

Remarks. This species is readily distinguished by its open whorls and by the character of its ornaments.

It is stated by de Koninck to have been found in the black limestone of Parkmore, in the county of Limerick, a specimen from that locality having been sent to him by Mr. W. H. Baily of the Geological Survey of Ireland.

Horizon. Calcaire Carbonifère (Assise VI.)=Carboniferous Limestone.

Locality. Visé, Belgium.

Represented in the Collection by a small fragment.

Gyroceras serratum, de Koninck.

1844. *Gyroceras serratum*, de Koninck, Destr. des Anim. Fossiles du Terr. Carb. de la Belgique, p. 533, pl. xlviii. ff. 2, *a*, *b*.

1849. *Nautiloceras serratum*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 112.

1880. *Gyroceras serratum*, de Koninck, Faune du Calc. Carb. de la Belgique, pt. ii. (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. v.) p. 10, pl. xxxii. ff. 5, 5 *a*, 5 *b*.

Sp. Char. Shell composed of one and a half or two whorls, completely out of contact, and with an obtuse initial point. The transverse section (except quite at the apex) is scutiform, the ventral or convex side forming a flattened area, which is bounded on either side by prominent raised areas, the whole increasing in breadth with the growth of the shell. The sides slope somewhat abruptly inwards to the concave border. The septa appear to be numerous, strongly concave, and the sutures bent backwards at the sides of the shell. The body-chamber occupies nearly $\frac{1}{3}$ of the last whorl. The siphuncle is situated a little above the centre. The ornaments of the shell consist of twenty-two prominent, longitudinal, parallel ridges, studded with small tubercles. On the convex side of the shell there are ten ridges, three of which on either side form two raised bands, marking off the central flattened area. Upon the latter are the four remaining ridges, the two centre ones being much stronger than those on each side of them. The remaining twelve ridges, which are all of equal strength, occupy the sides and inner border of the shell. The ornamentation here shows no trace of the contact of a previous whorl.

Remarks. This species closely resembles *G. consobrinum*, de Kon., but it differs from the latter by the greater number of its longitudinal ridges, and also by the form of the ventral side, which is much more excavated.

Horizon. Calcschiste de Tournai (Assise i. e) = Carboniferous Limestone.

Locality. Tournai, Belgium.

Represented in the Collection by two examples.

Subgenus **AIPOCERAS**, Hyatt¹.

(*Gyroceras*, de Koninck, 1880².)

This subgenus was instituted by Hyatt for the reception of a remarkable species described by de Koninck, which differs from *Gyroceras* proper in its much more rapid rate of tapering and its

Fig. 6.



Gyroceras (Aipoceras) compressum.—*a*, lateral view, showing some of the septa; *b*, front view. Drawn from a specimen in the Collection. One half natural size.

subangular section, in which the ventral (convex) side forms the apex of the triangle, and the dorsal the base. The whorls are not in contact. The septa are moderately distant and the siphuncle

¹ Proc. Boston Soc. Nat. Hist. 1883, vol. xxii. p. 296.

² Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. v.), p. 6.

close to the convex border. The shell is smooth. Found only in the Carboniferous Limestone of Belgium, Calcaires of Anseremme (Assise iii. *e*), of Furfooz (Assise iv. *b*), and of Panquys (Assise iv. *b*), and at the same horizon in Ireland. It is said by de Koninck to be rare in all the Belgium localities cited, and it is probably equally so in Ireland. Type, *Gyroceras gibberosum*, de Koninck¹.

Remarks. Professor Hyatt regards *Aipoceras gibberosum* as closely related to *Cyrtoceras Verneuillianum*, de Kon.², but he considers also that it is transitional to *Solenocheilus* (= *Asymptoceras*) in the position of the siphuncle, the smoothness of the shell, and the compressed outline of the whorls. *Gyroceras expansum*, Saemann³, may belong also to the same group as *Aipoceras gibberosum*.

***Gyroceras* (*Aipoceras*) *compressum*, Foord.**

Sp. Char. Shell composed of one and a half volutions. The curvature is not quite regular, the mature part of the shell forming a proportionally lesser curvature than the earlier. The initial point is slightly obtuse, and bears no trace of a cicatrix; it is inclined towards the dorsal side of the shell, and leaves a central opening of considerable size. At a little distance from the apex the section of the shell is obscurely oval, but at a later stage of growth it becomes subtriangular, and much higher than broad. There is a slight emargination in the superior border of the aperture. The septa are moderately distant from each other; the sutures are slightly concave at the sides of the shell, but without any sinus on the periphery. The siphuncle is not known. The body-chamber is very large, occupying about $\frac{2}{3}$ of the total length of the shell. The surface of the test is quite smooth, there being nothing but a few irregular lines of growth upon it. The test is excessively thin.

The specimen in the Collection (figure 6) differs sufficiently from *G. (A.) gibberosum*, de Kon., to warrant its separation from that species; it is much less inflated, the periphery being so narrow as almost to form a keel. The ratio of the ventro-dorsal to the transverse diameter is as 19 : 29, while in de Koninck's species it is as 20 : 24.

Remarks. Only five examples of the species are recorded by de Koninck, who compares it with the *Gyroceras expansum* of Saemann, to which he thinks it comes very near.

¹ Faune du Calcaire Carbonifère de la Belgique (Ann. Mus. Roy. d'Hist. Nat. de Belgique, tom. v.). p. 6.

² *Ibid.* p. 35, pl. xxxiv. ff. 9, *a-c*.

³ Palæontographica, 1854, Band iii. p. 167, tab. xxi. ff. 2, *a-c*.

Horizon. Carboniferous Limestone.

Locality. Ireland.

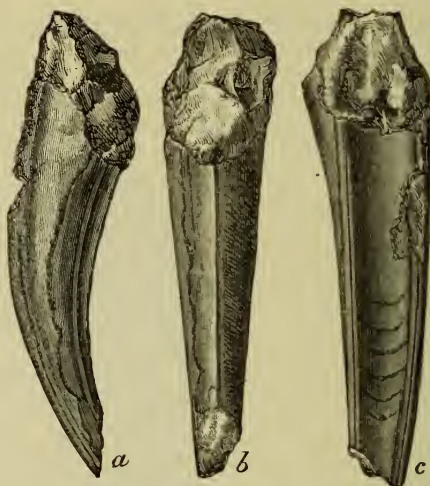
Represented in the Collection by a single example.

Subgenus **TRIGONOCERAS**, McCoy¹.

(*Orthocera*, J. de C. Sowerby, 1825²; *Orthoceras*, Phillips, 1836³; *Aploceras* (pars), d'Orbigny, 1849⁴; *Cyrtoceras*, Giebel, 1852⁵; *Cyrtoceras*, Barrande, 1867⁶; *Gyroceras*, de Koninck, 1880⁷; *Cyrtoceras* (subgenus of), Blake, 1882⁸.)

Subgen. Char. Shell rapidly tapering, the apical part forming half a volution, the rest gently curving. The section is scutiform,

Fig. 7.



Gyroceras (*Trigonoceras*) *paradoxicum*.—*a*, lateral view; *b*, front view, showing the strong dorsal keel; *c*, ventral or peripheral view, showing its shallowly depressed surface, bounded on each side by two ridges. Some of the septa are here obscurely seen. Drawn from a specimen in the Collection. About one half natural size.

¹ Synopsis of the Carboniferous Fossils of Ireland, 1844, p. 6.

² Mineral Conchology, vol. v. p. 81.

³ Geol. of Yorkshire, pt. ii. p. 239.

⁴ Prodr. de Paléont. Stratigr. vol. i. p. 112.

⁵ Die Fauna der Vorwelt, Band 3, Abth. i. p. 200.

⁶ Syst. Sil. du centre de la Bohême, vol. ii. pt. i. p. 448.

⁷ Faune du Calc. Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. v.), p. 7.

⁸ British Foss. Ceph. pt. i. pp. 54, 56.

the ventral side being hollowed out and bordered by prominent ridges, the sides gently convex and sloping gradually inwards till they meet in a sharp ridge in the median line of the concave side. The septa are moderately distant and form a deep sinus on the ventral side of the shell. The siphuncle is situated a little above the centre. The test is thin, its ornaments consist of distant, longitudinal ridges, which are very faint upon the sides, but are stronger upon the superior lateral angles, where there are three or four of them close together; there is a prominent ridge also along the median line of the concave side of the shell. The test has very fine close-set longitudinal lines which can only be seen with the aid of a lens.

This subgenus, so far as is known, is confined to the Carboniferous rocks of Ireland and Belgium. It is represented only by the two species described below.

Remarks. Some palæontologists—Giebel, Barrande, Blake, &c.—regard *Trigonoceras* as allied to, or even as a subgenus of, *Cyrtoceras*, but its scutiform section and whorled apex indicate its affinities rather with *Gyroceras*. With the latter it has been associated by de Koninck; but the fragment upon which he based his decision (evidently conspecific with Sowerby's *O. paradoxicum*) has a restored outline added to it, making $1\frac{1}{2}$ volutions, for which there is no warrant in any of the specimens described by Sowerby and M'Coy, nor in those contained in the British Museum.

***Gyroceras* (*Trigonoceras*) *paradoxicum*, J. de C. Sowerby, sp.**

- 1825. *Orthocera paradoxa*, J. de C. Sowerby, Min. Conch. vol. v. p. 81, pl. cccclvii.
- 1836. *Orthoceras paradoxicum*, Phillips, Geol. of Yorkshire, pt. ii. p. 239.
- 1844. *Orthoceras* (*Trigonoceras*) *paradoxicum*, M'Coy, Synop. of the Carboniferous Limestone Foss. of Ireland, p. 9.
- 1849. *Aploceras paradoxicum*, d'Orbigny, Prodr. de Paléont. vol. i. p. 112.
- 1852. *Cyrtoceras paradoxicum*, Giebel, Die Fauna der Vorwelt, Band iii. Abth. i. p. 200.
- 1855. *Orthoceras* (*Trigonoceras*) *paradoxicum*, M'Coy, British Pal. Foss. fasc. iii. p. 573.
- 1880. *Gyroceras paradoxicum*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. v.), p. 7, pl. xxxii. ff. 3, 3 a, 3 b.

Sp. Char. "Rapidly tapering, abruptly incurved towards the smaller end, forming about half a volution; external face gently concave, bounded by strong angles (slightly less than rectangular);

lateral faces equal to the external one in width, converging to a strong keel along the middle of the inner face, the outer half of the lateral faces flattened, the inner half of each abruptly rounded nearly to a quarter of a circle; surface under the lens marked with minute, subequal, slightly flexuous, longitudinal striæ (about thirty in the space of two lines); a few stronger longitudinal ridges on the lateral keels of the external face; lines of growth indistinct, broadly arched backwards on the external face, and converging at a very acute angle, directed backwards on the internal keel. A specimen of the last chamber, imperfect at each end, two inches long, has the lateral faces one inch four lines wide at the large end, and one inch wide at the smaller, the exterior face being one inch three lines wide at the large end; septa moderately convex; siphon a little excentric towards the external side" (*M'Coy*).

Remarks. None of the examples of this species in the British Museum have the coiled, apical part of the shell preserved. A fragment showing part of the body-chamber exhibits closer septa than the other specimens; a portion of the test shows distant longitudinal ridges, which are also faintly marked upon the cast. This may be a variety of *T. paradoxicum*, or even a new species, but it is not perfect enough to warrant the application of a new name to it.

De Koninck¹ figures a fragment of the present species and adds a dotted outline to it, supposing it to have been a shell consisting of about two widely separated whorls. Having, however, examined the original specimen in the Royal Museum of Natural History at Brussels, I can confidently affirm that there is not the least warrant for the attempted restoration in de Koninck's figure. The specimen in the Brussels Museum agrees perfectly with Sowerby's types in the British Museum, which are only very slightly curved, the apical extremity being, however, imperfect, so that the coiling of this part, as described by M'Coy, is not exhibited.

Horizon. Carboniferous Limestone.

Locality. Kildare, Cork.

Represented in the Collection by four specimens, including the type figured by Sowerby in the 'Mineral Conchology' (*loc. cit.*).

Gyroceras (Trigonoceras) aigoceras, Münster, sp.

1838. *Cyrtocera aigokeros*, Münster, Beiträge zur Petrefactenkunde, (1st ed.) Heft i. p. 33 (2nd ed.), Heft i. 1843, p. 56, Taf. i. ff. 7 a, 7 b, Taf. ii. f. 1.

¹ Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. v.), pt. ii. 1880, p. 7, pl. xxxii. fig. 3.

1844. *Gyroceras aigoceros*, de Koninck, Descrip. des Anim. Fossiles du Terr. Carb. de la Belgique, p. 532, pl. xlviii. ff. 1 a, 1 b.
1849. *Nautiloceras aigoceros*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 112.
1852. *Gyroceras aigoceras*, Giebel, Die Fauna der Vorwelt, Band iii. Abth. i. p. 193.
1854. *Nautiloceras aigoceras*, Pictet, Traité de Paléont. vol. ii. p. 630, pl. 1. f. 8.
1876. *Gyroceras aigoceras*, F. Roemer, Lethæa Palæozoica, Taf. xlv. f. 3.
1880. *Gyroceras aigoceras*, de Koninck, Faune du Calc. Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. v.), p. 8, pl. xxxii. ff. 4, 4 a, 4 b.
1883. *Trigonoceras paradoxicum* (young), Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 291.

Sp. Char. Shell discoid, composed of two whorls, quite disconnected. The initial point has not been seen. Section scutiform, the periphery hollowed out and bounded on each side by prominent ridges. The sides are compressed, slightly inflated in the middle, and narrowing to a sharp keel along the median line of the concave side. The body-chamber appears to have occupied about $\frac{1}{3}$ of the total length of the last whorl. The septa are numerous, their distance from each other at the sides of the shell being about $\frac{3}{4}$ of a line, where the diameter is 5 lines. The siphuncle is situated a little above the centre. The sides of the shell are ornamented with transverse acute plications, from 38 to 40 in each whorl. These plications cease at the obtuse keels or ridges which bound the peripheral side of the shell, and are not continued upon the latter. The entire surface of the test is covered with extremely fine longitudinal lines, which can only be seen with the aid of a lens.

Remarks. The transverse ornaments and hollowness of the periphery in this species give it a very characteristic aspect, and mark it off from the species of *Gyroceras* proper, with which it has been associated by de Koninck. Professor Hyatt's opinion, that *T. aigoceras* is only the young of *T. paradoxicum*, seems to rest upon the assumption that the latter was similarly coiled throughout its whole length, whereas it has been seen that the coiling is only at the apex, and that the shell is afterwards but slightly curved, a circumstance which has probably led some authors to place it (despite its very remarkable section) in the genus *Cyrtoceras*.

Horizon. Calcschiste de Tournai (Assise i. c) = Carboniferous Limestone.

Locality. Tournai, Belgium.

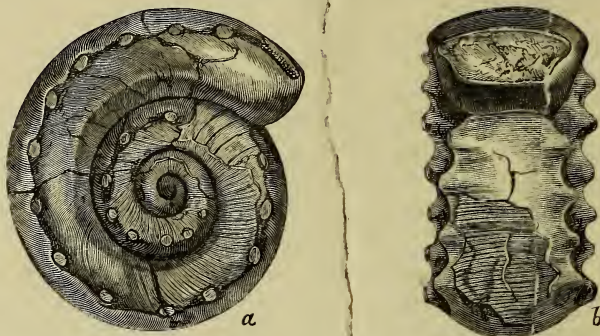
Fairly well represented in the Collection.

Genus **HERCOCERAS**, Barrande¹ (restricted

(*Gyroceras*, Barrande, 1854²; *Nautilus*, Barrande, 1856;
Nautilus, Blake, 1883⁴.)

Gen. Char. Shell discoid, whorls very slightly embracing, subquadrate in section; umbilicus wide, rather shallow, exposing all the volutions. Body-chamber equalling about half the length of

Fig. 83.



Hercoceras mirum, after Barrande.—*a*, lateral view, showing the stumps of the spines and a few septa; *b*, front view, showing the peculiar position and contracted form of the aperture. Some of the test is seen at the lower part of the figure. Copied from pl. cccc lxxvii. case 2, of the Syst. Sil. de la Bohême, vol. ii. Suppl. et Série tardive, 1877. The figures are reduced from figs. 3, 4, pl. xlii. (vol. ii.) of the same work.

the last whorl. Aperture much contracted by the inflexion of its margin, occupying the upper $\frac{2}{3}$ of the extremity of the whorl, and extending obliquely backwards so as to cut off a considerable portion of the convex border. This peculiar position of the aperture is due to the existence of a diaphragm, perpendicular to the axis and closing the extremity of the whorl transversely. Septa simple, moderately concave. Siphuncle cylindrical, situated very near the peripheral margin. Surface of the test ornamented with a row of strong, hollow spines along the lateral angle of the whorls; transverse lamellose striæ are also present, and form a conspicuous sinus upon the periphery.

¹ Défenses des Colonies, 1865, iii. p. 31; Syst. Sil. de la Bohême, vol. ii. 1867, p. 152.

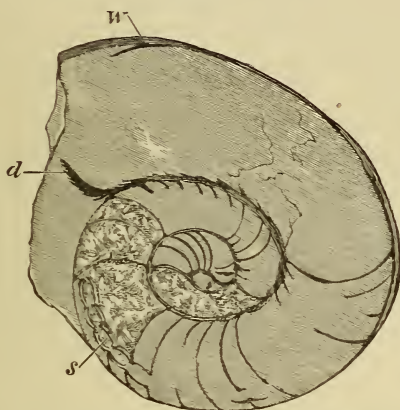
² Leonhard and Bronn's Jahrbuch, Heft i. p. 7, pl. i.

³ Bull. Soc. Géol. de France, vol. xiii. p. 333.

⁴ British Foss. Ceph. pt. i. p. 62.

Remarks. A more detailed description of the peculiar diaphragm mentioned in the above diagnosis may here be given. (See fig. 9.) It may be considered, says Barrande, as a true septum, similar to the one which forms the base of the body-chamber, but with its concave side directed inwards, and so characteristic is this position of the diaphragm that if an isolated body-chamber is found, it is

Fig. 9.



Hercoceras mirum.—*w*, shell-wall; *d*, diaphragm; *s*, siphuncle. Copied from plate ccxli. fig. 3, of Barrande's 'Système Silurien du Centre de la Bohême,' vol. ii. pt. i. 1866. Reduced from the original figure about one half.

difficult to distinguish the anterior from the posterior extremity. To compensate for this closing of the extremity of the spire, there is a deep emargination, occupying the whole breadth of the convex wall of the shell. This aperture is of trapezoidal form, the upper side of the trapezium corresponding with the border of the diaphragm. The other two sides slope obliquely inwards. (See fig. 8, *b*.) Upon each of the lateral borders of the orifice there is a more or less deep lobe, varying in form and position. Thus, the lateral border may be merely interrupted by a wide and shallow sinus near its posterior extremity, or there may be, instead, a deep lobe at the lateral angles. (See Barr. Syst. Sil. vol. ii. pl. cii. ff. 4, 6, 7, 8.) These lobes recall those observed in the large orifice of *Phragmoceras*. Barrande observes that the varying development of these lobes may be the result of the state of preservation of the individual observed, or their relative age and the degree of absorption that the test has undergone. In fact it is found that the test composing the body-chamber and the diaphragm, instead of being a wall simple in

construction, consists of a great many lamellæ which were applied successively to the exterior of the shell; and by absorbing them gradually from the inside the mollusc could, in spite of the diaphragm, increase the length of its shell like other *Nautili*.

The general appearance of *Hercoceras*, as Barrande remarks, suggests its affinities with *Nautilus*, but the form and peculiar position of the aperture are characters which distinguish it from all other genera. I therefore propose to restrict the genus *Hercoceras* to species in which these singular features are observable, and not to include in it, as Professor Hyatt has done, other species, such as *Gyroceras alatum*, Barr., and *Trochoceras flexum*, Barr., in which they are absent.

The only species of *Hercoceras* known is *H. mirum*, Barr. (with its variety *irregularis*); its description, therefore, includes many of the characters of the genus. All the specimens representing the genus are found in one district, viz. between Klukovitz and Hlubočep, near Prague. They all belong to Étage G, bande g 3 (=Downtonian). The genus *Hercoceras* thus appears to have had a very limited range, both in time and space, though further examination of bande g 3 might show that its horizontal range is more extended than it has yet proved to be.

***Hercoceras mirum*, Barrande.**

1865. *Hercoceras mirum*, Barrande, Défense des Colonies, iii. p. 31.

1867. *Hercoceras mirum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 153, pl. xlii., pl. xliii. ff. 1-7 (var. *irregularis*), pl. cii., pl. ccxli. ff. 1-5, pl. cccclxxvii. case ii.

1883. *Hercoceras mirum*, Hyatt, "Genera of Fossil Cephalopods," Proc. Boston Soc. Nat. Hist. vol. xxii. p. 283.

Sp. Char. Shell forming about four volutions in adult examples. The whorls only slightly embracing. Transverse section an elongated ellipse, one side of which is emarginate. In certain specimens the elliptical outline becomes almost quadrate, but the ventro-dorsal is always less than the transverse diameter, except just at the apex of the shell. The body-chamber occupies about half of the last whorl, and its manner of development corresponds with that of the internal volutions. In the majority of specimens it is in contact with the preceding whorl, but in some individuals it frees itself and is produced in a curved, or an approximately straight line. Such specimens are classed by Barrande as a variety, under the name *irregularis*. The structure of the aperture and the ornamentation of the shell have already been described under the generic diagnosis.

Remarks. Barrande draws attention to the resemblance between *Hercoceras mirum* and *Nautilus subtuberculatus*, G. & F. Sandberger (Die Verstein. Nassau, 1856, p. 133, pl. xii. f. 3), in the general form of the shell, the slightly embracing whorls, ornaments of the test, &c. A complete comparison between the two forms cannot, however, be made, as the aperture in *N. subtuberculatus* is wanting.

It may be mentioned that Dr. E. Kayser¹ places some examples of the last-named species from the Hartz in Barrande's genus *Hercoceras*, but with some doubt, remarking that the Rhenish and Hartz form corresponds in all observed characters with *Hercoceras mirum*, and if the aperture should prove to be similar the analogy between the two species would be complete. My own opinion is that the two forms—*Hercoceras mirum* and *Nautilus subtuberculatus*—are *specifically* distinct (the enormous development of the spines in the former being quite sufficient to separate it from the latter), but as to whether they belong to the same genus or not can only be determined by the discovery of more perfect specimens of *N. subtuberculatus*.

Horizon. Étage G, bande g 3 (= Downtonian).

Locality. Hlubočep, Bohemia.

Well represented in the Collection.

Genus **BARRANDEOCERAS**, Hyatt².

(*Uranoceras*, Hyatt³.)

Gen. Char. Shell discoid, compressed, rather widely umbilicated, exposing all the volutions, with a large central perforation; increasing rather rapidly in diameter. Section sublanceolate, the concave wider than the convex side. Septa deeply concave, rather distant; the sutures forming a shallow sinus upon the sides of the shell and upon the periphery. Surface of the test transversely costate, or provided merely with lines of growth.

Type, *Nautilus natator*, Billings⁴.

Ordovician to Silurian.

Remarks. With *Barrandeoceeras* may be associated *Cyrtoceras Uranum*, Barrande (= *Uranoceras Uranum*, Hyatt), of the Silurian

¹ 'Die Fauna der ältesten Devon-Ablagerungen,' in Abhandl. zur geol. Spezialkarte v. Preussen, 1878, Band ii. Heft iv. p. 83.

² Proc. Boston Soc. Nat. Hist. 1883, vol. xxii. p. 299.

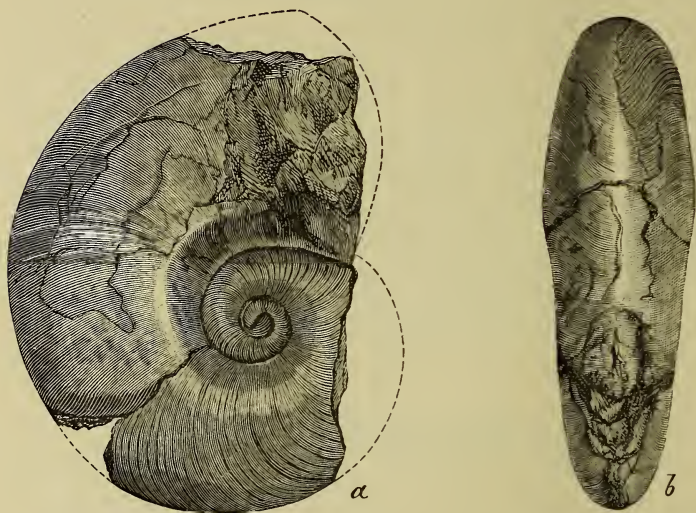
³ Ibid. p. 298.

⁴ Canadian Naturalist and Geologist, 1859, vol. iv. p. 466. *N. natator* not having been figured, I have given a figure of *N. Bohemicum*, Barr.

of Bohemia. This has slightly embracing whorls, of which the dorsal side is broader than the peripheral. The whorls enlarge somewhat rapidly, and there is a central perforation of considerable size.

It should be mentioned that Professor Hyatt finds in the "Group of *Nautilus ophioneus*" of Waagen¹ (= *Pselioceras*, Hyatt²), a very

Fig. 10.



Barrandeoceras Bohemicum.—*a*, lateral view, the broken parts restored with a dotted line; the body-chamber begins at the gap on the left of the figure: *b*, peripheral view. Drawn from a specimen in the Collection. About one half natural size.

close resemblance to the adults of *Barrandeoceras natator*, Bill., especially "in the sutures, and form of the larval and adolescent stages of the former." He observes, however, that Waagen's species "also resemble the genus *Discites* in general aspect, during the later adolescent and adult stages."

¹ Mem. Geol. Surv. India.—Palæont. Indica—ser. xiii. Salt-Range Fossils, 1879, vol. i., Productus-limestone Fossils, p. 46.

² Proc. Boston Soc. Nat. Hist. 1883, vol. xxii. p. 299.

SILURIAN SPECIES.

Barrandeoceras Bohemicum, Barrande, sp.

1838. *Lituites Biddulphii*, J. de C. Sowerby, in Murchison's 'Silurian System,' p. 626, pl. xi. f. 8.
1854. *Nautilus Bohemicus*, Barrande, Leonhard & Bronn's Jahrbuch, Heft i. p. 6.
1867. *Nautilus Bohemicus*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 146, pl. xxxii., pl. xxxiii., pl. xxxiv. ff. 1, 2, pl. xxxv. f. 1.
1877. *Nautilus Bohemicus*, Barrande, ibid. Supplém. et Série tardive, pl. cccclxxvi. case xi. (young).
1882. *Nautilus Bohemicus*, Blake, British Foss. Ceph. pt. i. p. 210, pl. xxvii. ff. 1, 2.
1883. *Barrandeoceras Bohemicum*, Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 299.

Sp. Char. The shell has a flattened discoid form, with not more than three volutions, the breadth of which is more than double the thickness; they are all exposed, and there is a central vacuity. Each whorl overlaps the preceding one to the extent of about $\frac{2}{5}$ its own breadth. The umbilicus is therefore very wide, but it is shallow. The transverse section is elliptical, and is rather deeply emarginate on the concave side owing to the overlapping of the whorls, just described. The convex border is subtruncate instead of being rounded. The ventro-dorsal is to the transverse axis as 2:1. The body-chamber occupies half the external whorl, and is always in contact with the preceding whorl. The aperture, which has been observed in a great many specimens in all stages of growth, is situated in the plane of the last septum, and its form is similar to that of the transverse section. It presents a deep emargination on the periphery. The distance between the septa increases regularly but slowly, not exceeding $\frac{1}{10}$ the ventro-dorsal diameter. The sutures form a wide, shallow sinus upon the sides of the shell, and are strongly elevated upon the periphery. The siphuncle is situated between the centre and the periphery, but nearer the former than the latter. Its elements are cylindrical. The test is ornamented merely with lines of growth, which are somewhat stronger in the superior third of the sides of the whorls. They form a deep sinus upon the periphery, corresponding with that of the aperture. Young individuals have, besides the lines of growth, a series of very fine longitudinal lines, which do not apparently pass the limits of the first whorl. The cast of the body-chamber is marked with exceedingly fine, anastomosing lines (epidermids), representing the surface of the mantle of the animal.

Remarks. The species most closely allied to this one are the

following:—(1) *Barrandeoceras Sternbergi* (pl. xxxvi.), which has its volutions only just touching each other, and they are also thicker; the septa also are much more distant. (2) *B. Sacheri* (pl. xxxix.) is relatively of much smaller size, and is ornamented with striæ disposed in groups. (3) *B. tyrannus* (pl. xxxviii.) enlarges much less rapidly; its body-chamber is longer and its siphuncle narrower. There are two specimens in the Collection, from the British Wenlock beds, which belong undoubtedly to this species. They both show some of the septa, with their sigmoidal sutures, together with part of the body-chamber, and in one of them the subcentral siphuncle is seen.

Horizon. Étage E (=Salopian).

Localities. *British:* England (precise locality unknown). *Foreign:* Karlstein, Bohemia.

Well represented in the Collection, which contains specimens in different stages of growth, from the initial to the adult.

***Barrandeoceras Sternbergi*, Barrande, sp.**

1854. *Nautilus Sternbergi*, Barrande, Leonard & Bronn's Jahrbuch, Heft i. p. 6.

1867. *Nautilus Sternbergi*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 147, pl. xxxvi., pl. xxxvii., pl. xli.

1883. *Barrandeoceras Sternbergi*, Hyatt, "Genera of Fossil Cephalopods," Proc. Boston Soc. Nat. Hist. vol. xxii. p. 299.

Sp. Char. The shell is discoid and flattened, like its congeners, with from three to four volutions, whose breadth is to their thickness as 3:2. They are all exposed, as there is no overlapping. There is a central vacuity. The transverse section is elliptical, the ratio of the two diameters being as 3:2. That end of the ellipse corresponding to the concave side of the shell is rounded like the other end, owing to the whorls not in the least overlapping. The increase in breadth of the last whorl is in the ratio of 1:3, and the thickness varies as 3:8 in the same length. The body-chamber occupies about half of the last whorl. The aperture lies apparently in the plane of the last septum, but it is imperfect in all the specimens examined. The distance of the septa in the middle of the sides of the shell in the largest specimens is equal to $\frac{1}{5}$ of the ventro-dorsal diameter; their convexity amounts to $\frac{1}{3}$ of the same. The sutures form a shallow sinus upon the sides of the shell, and arch upwards towards the periphery. The siphuncle is situated a little above the centre. The test is ornamented only with very fine transverse lines of growth, so that it appears quite smooth when looked at with the naked eye.

Remarks. The difference between this species and *B. Bohemicum*, its nearest ally, has already been pointed out.

Horizon. Étage E (= Salopian).

Locality. Lochkow, Bohemia.

Fairly well represented in the Collection.

***Barrandeoceras tyrannus*, Barrande, sp.**

1867. *Nautilus tyrannus*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 148, pl. xxxviii., pl. xxxix. ff. 9-11, pl. xl.

1877. *Nautilus tyrannus*, Barrande, *ibid.*, Supplém. et Série tardive, p. 200, pl. cccclxxvi. case i (young), pl. cccclxxxix. case ii (initial point, showing cicatrix), pl. dxliv.

1883. *Barrandeoceras tyrannus*, Hyatt, "Genera of Fossil Cephalopods," Proc. Boston Soc. Nat. Hist. vol. xxii. p. 299.

Sp. Char. Shell discoid, flattened, forming from three to four whorls, the ratio of their breadth to their thickness being as 2 : 1; all are exposed, and there is a considerable vacuity in the centre. The whorls are only just touching, so that there is scarcely any impression upon the concave side. The umbilicus is wide but shallow. The initial portion of the shell has the form of a little hook, and makes scarcely half a volution. The transverse section is ovate, the larger extremity corresponding with the concave side of the shell, the opposite or peripheral side being narrowly rounded. The ventro-dorsal is to the transverse axis as 2 : 1. The whorls increase in diameter in the ratio of 2 : 7. The body-chamber occupies a little more than half the last whorl. The aperture is situated in the plane of the last septum. The septa attain a maximum distance from each other representing $\frac{1}{7}$ of the ventro-dorsal diameter, and their convexity is equal to $\frac{1}{4}$ of the same. The sutures form a wide shallow sinus upon the sides of the shell, and are strongly arched upon the periphery. The siphuncle is situated a little above the centre; its elements are cylindrical. The test is ornamented with oblique striæ of growth, which in the young shell are tolerably regular, fine, and close-set. On the last whorl in the adult shell they become more unequal, both in strength and distance, from each other; sometimes, again, they are separated by wide grooves; they always form a deep sinus upon the periphery. There are traces of longitudinal striæ upon the young shell, as is commonly the case in many genera of the Nautilidæ. The cast of the body-chamber is covered with epidermids.

Remarks. This species attains a larger size than any of its congeners in Bohemia. Barrande estimates the diameter of some specimens in his collection at 300 millim. The nearest species to

B. tyrannus is *B. Bohemicus*, the whorls of which, however, increase more rapidly in breadth, and it has a smaller umbilicus; its body-chamber is also shorter, and wider at the aperture.

Professor Blake regards the two species *tyrannus* and *Bohemicus* as identical, but on comparison they appear to me to be sufficiently distinct from each other at all stages of growth to warrant their being kept separate.

Horizon. Lower Ludlow.

Locality. Ledbury.

Represented by a fine specimen, presented by G. H. Piper, Esq., F.G.S., and another example, very imperfect, probably from Dudley.

Barrandeoceras Holtianum, Blake, sp.

1865. *Lituites Holtianus*, Salter, Cat. of Museum of Practical Geology, p. 75 (name only).

1882. *Nautilus Holtianus*, Blake, British Foss. Ceph. pt. i. p. 211, pl. xxviii. f. 1.

Sp. Char. "The rate of increase and breadth of the last whorl vary very little in the different examples; the greatest breadth is .54. The section may be more or less due to compression, as all examples are more or less imbedded in the stone. The shape is always as in the type in adult forms, but more quadrate in the young, the maximum thickness observed being $\frac{1}{2}$ the breadth. On the outer whorl of some are seen slight undulations of growth towards the inner side, and a few backward-curving lines; on the inner whorls there are about 40 gently backward-curving feeble ribs. The surface is also covered by very fine riblets, 11 per line, and by transverse epidermids in some specimens. The body-chamber has a slight tendency to leave the coiled portion, and reaches on the average about $\frac{1}{3}$ of a whorl [in length]. The inner side of the aperture is slightly produced, and the middle has a forward curve, and in some there is a slight constriction there. The septa are from 20 to 34 per whorl; fewer at first, but increasing in number continually; not very convex in the suture, but curving forward very rapidly both inside and outside, making almost a funnel-shaped lobe at the former place. The siphuncle is not accurately determined in any, but one example had some indications of an internal siphuncle, but in another it looks more probably central.

"The great proportionate breadth of the outer whorl distinguishes this from *N. Bohemicus*. It is quite symmetrical, and is therefore

not a *Trochoceras*, though its young form might have some resemblance to *T. cornu-arictis*." (Blake.)

Remarks. This appears without doubt to be the "*Nautilus Hol-tianus*" of Blake. The specimens, though crushed, give a good idea of the character of the shell, one especially showing the coarser sculpture and septation very satisfactorily.

Horizon. Wenlock Limestone.

Locality. Dudley, Worcestershire.

Represented in the Collection by two examples.

Barrandeoceras Sacheri, Barrande, sp.

1867. *Nautilus Sacheri*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 149, pl. xxxix. ff. 1-8.

Sp. Char. Shell discoid, flattened, with scarcely three volutions, their breadth nearly double their thickness; entirely exposed, with rather a large central vacuity. The whorls are only slightly enveloping, a very slight groove on the dorsal side marking their contact. The young shells are hook-like in shape, their curvature not exceeding half a volution. The transverse section is an ellipse with a very slight emargination on the inner (dorsal) side. The ventro-dorsal is to the transverse axis as 3:2. The increase in breadth of the last whorl is in the ratio of 1:3. The body-chamber occupies nearly half the last whorl, and its capacity considerably exceeds that of the whole of the septal chambers. The aperture has a very well-marked sinus on the convex margin. The distance between the septa, measured upon the sides of the shell, amounts to about $\frac{1}{6}$ of the ventro-dorsal diameter; their convexity equals $\frac{1}{3}$ of the same. The sutures form a broad and shallow sinus upon the sides of the shell, and are strongly arched forwards upon the periphery. The siphuncle is situated a very little above the centre; its elements are cylindrical. The surface is ornamented with regular undulations, which may be regarded as feeble ribs, as they slightly mark the cast; they are most strongly developed in the young shell, and become obsolete towards the aperture in adults. They have an oblique direction, and thus cross the sutures nearly at a right angle, producing a deep sinus upon the periphery, which corresponds with the emargination in the aperture, already described. It should be remarked that the ribs tend to become more feeble in approaching the periphery. The whole surface of the test is covered with fine and somewhat irregular lines corresponding in direction with the ribs. The cast of the body-chamber is covered

with epidermids, representing the surface of the mantle of the mollusc.

Remarks. This species is distinguished from its congeners by its small size, and by the ribs which ornament the surface.

Horizon. Étage E (=Salopian).

Locality. Lochkow, Bohemia.

Fairly well represented in the Collection.

DEVONIAN SPECIES.

Barrandeoceras oriens, Hall, sp.

1876. *Nautilus oriens*, Hall, Illustrations of Devonian Fossils: Cephalopoda, pl. lxi. f. 1.

1879. *Nautilus oriens*, Hall, Nat. Hist. of New York, Palæontology, vol. v. pt. ii. p. 420, pl. lxi., pl. cv. f. 2, pl. cvi. f. 8.

1879. Cf. *Nautilus maximus* (Conrad), Hall, ibid. p. 418, pls. lxiii., lxiv.

Sp. Char. "Shell large, subovoid, discoid, making about three volutions, which are slightly re-entrant [overlapping]. Umbilicus very wide, exposing all the volutions. Transverse section subcircular. Tube somewhat gradually enlarging in the inner volutions. The apical angle, as taken from a compressed specimen, is about 15°.

"Chamber of habitation large, ventricose, rapidly expanding. Aperture opening at right angles to the axis of the tube, with a gentle sinus on each side of the convex ventral face of the shell. Air-chambers regular, deep, increasing in depth with the enlargement of the volutions. The measurements of two specimens give a depth of twenty to twenty-five mm.

"Septa regular, distant, having a greater concavity than the depth of the air-chambers, strongly imbricating. As measured on the ventrum of one specimen, they have a distance of twenty-five mm., where the tube has a diameter of seventy-five mm. Suture lines strongly marked on the casts and partial casts of the interior.

"Test imperfectly preserved, and its thickness not determined. In the compressed and macerated specimens, partially retaining the shell, or its impressions upon the cast, the surface is shown to have been marked by fine, lamellose, somewhat undulating striæ of growth, and finer elevated lines, which are interrupted by coarser revolving striæ, and these are especially conspicuous on the dorsal side, on the margins, and within the cavity of the umbilicus, forming low rounded ridges, which are at unequal distances. Similar,

but less conspicuous, revolving striæ or low ridges, are often preserved over the ventral face of the shell, while a single specimen preserves the marks of obsolescent, low undulations, as in some specimens of *N. sublivatus*. In another specimen, near the aperture, there is a belt more than twenty mm. wide, which is strongly marked by rounded, transverse undulating striæ, the undulations being caused by slender revolving striæ, of which there are six or seven in the space of five mm.

"The internal cast is essentially smooth and polished (this feature being due to the nature of the matrix), with the exception of the suture lines, the impressions of the transverse striæ, and the obscure radiating striæ, and obsolescent undulations. The largest individual observed has a diameter of about 200 mm., as measured across the volutions at the base of the grand chamber; the entire individual has been much larger.

"This species has its nearest relations with *N. maximus*, and possesses many features in common with that form. With a single exception all the specimens are laterally compressed, and this may conduce to the contraction of the umbilicus and the apparent re-entrant character of the volutions which is observed in comparison. The specimens are preserved in a soft, fissile black shale, and the surface markings are more distinctly retained upon the cast, or upon the adhering inner laminæ of the shell, than in *N. maximus*, which is usually imbedded in a coarser material. The pitted and mammillary deposit, which everywhere marks the exfoliated specimens of *N. maximus*, is either entirely absent, or scarcely at all observable on the specimens of *N. oriens*.

"This form is distinguished from *N. magister* by its comparatively wide umbilicus, the greater exposure of the inner volutions, the nearly circular transverse section, and sinus in the aperture. The surface-markings and the absence of nodes on the ventro-lateral margins are distinctive features." (*Hall*.)

Remarks. The individual representing this species in the British Museum, though much crushed, shows with sufficient clearness the characters described by Hall. The septate portion only is preserved.

Horizon. Hamilton Group (Middle Devonian).

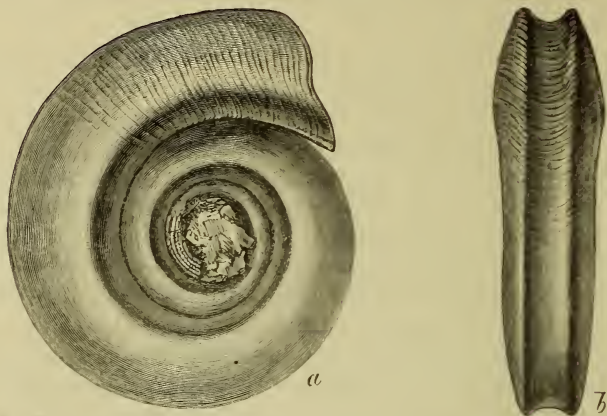
Locality. New York State.

Represented in the Collection by a single example.

Genus **DISCITES** (de Haan¹), M'Coy².

(*Nautili Ornati* (pars), de Koninck³; *Nautili Disciformes*, de Koninck⁴; *Discitoceras*, *Pselioceras*, Hyatt⁵.)

Fig. 11.



Discites compressus.—*a*. Lateral view of a nearly perfect specimen, showing faint lines of growth on the body-whorl, and the characteristic cancellated sculpture in the young shell. *b*. Peripheral view, showing the deep sulcus. Drawn from a specimen in the Collection. About two thirds of the natural size.

Gen. Char. Shell discoid, much compressed, the umbilicus wide, shallow, and exposing all the inner volutions and the small central vacuity; the volutions only just in contact, or very little embracing, narrow, increasing gradually in size, quadrangular in section, channelled or flattened on the periphery. Body-chamber occupying one half of the last whorl. The latter becomes separated from the rest of the shell for a distance of $\frac{3}{4}$ to $1\frac{1}{2}$ inch in adult shells. The dorsal side is marked by a median ridge bordered by two grooves corresponding with the ventral channel and its bordering ridges. Septa straight, or slightly arcuate on the sides and peri-

¹ Monographiam Ammoniteorum et Goniatiteorum, 1825, p. 41.

² Synop. Carboniferous Foss. of Ireland, 1844, p. 17.

³ Calc. Carb. de la Belgique, 1878 (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), p. 90.

⁴ Ibid.

⁵ Proc. Boston Soc. Nat. Hist. 1883, vol. xxii. p. 292; *ibid.* p. 299.

phery. Surface ornamented with transverse lines of growth; the young having also fine longitudinal ridges which become obsolete in the adult¹. Some species (*Nautilus sulcatus*, J. Sowerby, *e. g.*) are furnished with a number of revolving sulci.

Type, *Nautilus (Discites) discors*, M'Coy². Carboniferous.

Remarks. As the first species described by M'Coy—*D. costellatus*—which would naturally have been taken as the type of *Discites*, disagrees with his definition of the genus, the second in order of description has been selected, viz. *Discites discors*, M'Coy.

Hyatt³ has taken *D. costellatus* as the type species, stating that it was apparently the young of a species similar to *D. discors*, M'Coy. This opinion is, however, contradicted by the evidence of the specimens in the British Museum, which clearly show that the young of *Discites* did not resemble *D. costellatus* in the slightest degree. The latter is strongly ridged and has a broadly rounded periphery, the whorls being in section much wider than high, which is exactly the reverse of what is the case in *D. discors*. The longitudinal ornaments in the young of the latter are, moreover, very much finer than in *D. costellatus*, and in fact are best described as "fine thread-like lines," to which the term "costellate" would certainly be very inappropriate.

Professor Hyatt⁴ has proposed the name *Discitoceras* in lieu of *Discites*, on the ground that the latter has been used by Walch and Schlotheim for other molluscan genera; but as it has not been retained for the types to which those authors applied it, there can be no reason why it should not be employed for the section founded by M'Coy, which has now become so familiar to palæontologists.

Discites Omalianus, de Koninck, sp.

1836. *Nautilus tetragonus*, Phillips, Geol. of Yorkshire, pt. ii. p. 233, pl. xvii. f. 24, pl. xxii. ff. 33, 34.

1851. *Nautilus Omalianus*, de Koninck, Descrip. des Anim. Foss. du Terr. Carb. de la Belgique, Supplém. pp. 61, 711 (doubly paged), pl. lx. ff. 3, a-d.

1854. *Nautilus (Discites) tetragonus*, Morris, Cat. British Foss. 2nd ed. p. 309.

Sp. Char. Shell discoid, bluntly pointed at the apex, somewhat compressed laterally; composed of about three volutions, all ex-

¹ The shell is never "nodiferous" in this group, as Meek has described it.

² Synop. of the Carboniferous Foss. Ireland, 1844, p. 17.

³ Proc. Boston Soc. Nat. Hist. 1883, vol. xxii. p. 292.

⁴ Ibid.

posed, only just in contact, and leaving a large central vacuity. Section subquadrangular, somewhat inflated laterally, and flattened above and below. The ventral side is very broad and perfectly flat, the dorsal narrow and scarcely at all impressed by the enveloping whorls. The sides, which are about two thirds the breadth of the periphery, are a little inflated in the lower third, and slope gently inwards towards the periphery, the border of which forms an obtuse angle with the sides. The aperture makes a sigmoid curve at the sides and is deeply emarginate above. The septa are moderately concave, and tolerably near to each other. The siphuncle is situated on the ventral side, close to the margin.

The ornaments of the test consist of fine longitudinal lines which appear to be developed only upon the upper half of the sides, and upon a limited portion of the flattened periphery. Here (and also upon the upper part of the sides) they become stronger and wider apart, and have one or two still finer lines between them, but they disappear altogether at about one fourth the distance across the periphery. The longitudinal lines are crossed sigmoidally upon the sides by equally delicate transverse ones, and by the intersection of the two a very beautiful moniliform ornamentation is produced, which, however, can only be seen by the aid of a lens. It is well figured by de Koninck (*loc. cit.* fig. 3*d*). The transverse lines form a deep sinus upon the periphery, corresponding with the emargination in the edge of the aperture.

Remarks. According to the strict letter of the law of priority, Phillips's name should be adopted for this species, but his description and figures are so defective that it would be quite impossible to recognize the fossil thereby. Therefore it seems justifiable in the interests of science to substitute de Koninck's name for that of Phillips's (the two species being clearly identical), de Koninck's figures and description being perfectly satisfactory.

Horizon. Carboniferous Limestone.

Localities. *British.* Northumberland?—*Foreign.* Visé, Belgium.

Represented in the Collection by two examples, one of which is the type of Phillips's species, and is contained in the "Gilbertson Collection."

Discites Leveilleanus, de Koninck, sp.

1844. *Nautilus Leveilleanus*, de Koninck, Descrip. des Anim. Foss. du Terr. Carbonifère de la Belgique, p. 552, pl. xlix. ff. 1, *a*, *b* (pl. xxv. f. 1 excl.).

1849. *Nautilus Leveilleanus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 110 (*non* *ibid.* Paléont. Universelle, vol. i. pl. lxxxix.).

1852. *Nautilus Leveilleanus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 170.
1854. *Nautilus Leveilleanus*, Morris, Cat. British Foss. 2nd ed. p. 309 (excl. synonym.).
1854. *Nautilus Leveilleanus*, Pietet, Traité de Paléontologie, vol. ii. p. 623, pl. l. f. 3.
1878. *Nautilus Leveilleanus*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), pt. i. p. 143, pl. xxviii. ff. 6 a, 6 b, 6 c.

Sp. Char. Shell discoid, with a somewhat pointed apex, laterally compressed, composed of about four contiguous volutions, with a moderately large central vacuity. Transverse section subquadrangular, a little inflated at the sides, and somewhat depressed above and below. The section of the first and part of the second whorl is nearly circular. In consequence of the entire absence of angles or keels upon any part of the sides, the umbilicus is not well defined, nor is it deep. The septa are moderately concave; their distance cannot be ascertained owing to all the known specimens being covered by the test. The siphuncle, as seen in the specimen in the British Museum Collection, is situated close to the ventral border. The whole of the surface of the test is covered by fine, close-set, wavy lines of growth, which are quite visible to the naked eye. These are crossed by somewhat stronger longitudinal lines, which cover the whole of the shell in the young, but only the upper part of the sides and the periphery in the adult. The intersection of the transverse and longitudinal lines gives a granular appearance to the sculpture, which is particularly noticeable in the young shell.

Remarks. Some authors, says de Koninck, have confounded the present species with others, with which it is doubtless intimately connected, but from which it may, nevertheless, be readily distinguished. Thus, Morris allies it with the *N. planotergatus*, M'Coy, which is a much larger shell, with thicker whorls, rounded periphery, and much more coarsely ornamented. D'Orbigny also figures, under the name of *N. Leveilleanus*, a species in which the first whorls of the spire are much more slender and the striæ of growth stronger and less numerous than those of the present species.

A fine example in the Collection gives the following measurements:—Greatest diameter of the shell 5 inches, of the umbilicus $2\frac{1}{2}$ inches, of the outer volution a little over $1\frac{1}{2}$ inches. De Koninck gives admirable figures of this species (*loc. cit.*), which he says is rare in Belgium.

Horizon. Calcaire Carbonifère Supérieur (Assise vi.)=Carboniferous Limestone.

Localities. *British.* Kildare ; Naas, near Dublin.—*Foreign.* Visé, Belgium.

Well represented in the Collection by several fine specimens.

Discites discus, J. Sowerby, sp.

1812. *Nautilus discus*, J. Sowerby, Min. Conch. vol. i. p. 39, pl. xiii.

1854. *Nautilus (Discites) discus*, Morris, Cat. Brit. Foss. p. 308.

1855. *Nautilus (Discites) discus*, M'Coy, British Pal. Foss. fasc. iii. p. 558.

1878. *Nautilus difficilis*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), pt. i. p. 118, pl. xxvi. f. 5.

Sp. Char. "Depressed, edge flat, aperture oblong, volutions not concealed by each other.

"About four inches in diameter ; greatest thickness or width of the aperture half an inch. Turns of the spire about five. Chambers very numerous. Septa distant from each other about one-eighth of an inch. Outer edge of the aperture narrower than the inner one, notched, owing to a small groove which runs round the outer edge [periphery] of the shell. Siphuncle nearer to the inner edge of the septa." (*Sowerby.*)

Remarks. This species is closely allied to the *Nautilus (Discites) trochlea* of M'Coy, which, however, differs, as M'Coy has pointed out, in having a "much shorter and wider mouth, and smaller and deeper umbilicus, and the consequent much greater thickness, or less lateral compression, in proportion to the diameter"¹.

I can find nothing by which to separate the present species from *N. difficilis*, de Koninck, which is merely a young example of our shell ; but being a more complete specimen, it gives the proportions of the shell more accurately than can be gathered from the type specimen, which is not so perfect. Sowerby has restored it in his figure.

Horizon. Carboniferous Limestone.

Locality. Kendal, Westmorland.

Represented in the Collection by the type specimen, which is contained in the "Sowerby Collection."

Discites discors, M'Coy.

1844. *Nautilus (Discites) discors*, M'Coy, Synop. Carboniferous Foss. Ireland, p. 17, pl. iii. f. 5.

¹ British Palæozoic Fossils, fasc. iii. p. 561, pl. 3 n. f. 16.

1847. *Nautilus discors*, d'Orbigny, Paléontologie Universelle, vol. i. pl. xci. ff. 1, 2.
 1849. *Nautilus discors*, d'Orbigny, Prodr. de Paléont. Statigr. vol. i. p. 110.
 1852. *Nautilus discors*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 177.
 1854. *Nautilus discors*, Morris, Cat. of British Foss. p. 308.
 1860. *Discites discors*, Griffith, Journ. Geol. Soc. Dublin, vol. ix. p. 56.
 1878. *Nautilus discors*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), pt. i. p. 143, pl. xxx. ff. 8 a, 8 b.
 1883. *Discitoceras discors*, Hyatt, "Genera of Fossil Cephalopods," Proc. Boston Soc. Nat. Hist. vol. xxii. p. 292.

Sp. Char. "Discoid, compressed, whorls five, entirely exposed [only just in contact], quadrate, back convex, equal in width to the sides exclusive of the umbilical slope, sides slightly flattened, evenly convex; surface of the young shell (and inner whorls of the old) marked with strong longitudinal (spiral) sulci, crossed by very fine striæ; last volution of adult specimens marked with coarse transverse sigmoidal striæ only.

"I have named this species from the remarkable difference in striation between the young and old volutions, which is so great that they might be taken for different species; it resembles the *N. subsulcatus*, Phill., most nearly, but is distinguished by the character of the striation, and by not having, at any period of growth, either the two keels on the back, the keel on the sides, or any concavity on the latter, the sides being regularly convex, and the back broader in proportion to the width of the sides . . ." (*M'Coy*.)

Remarks. M'Coy's accurate description leaves nothing to be added to the diagnosis of this species.

Horizon. Carboniferous Limestone.

Locality. Naas, near Dublin.

Represented in the Collection by a single example.

***Discites compressus*, J. Sowerby, sp.**

1813. *Ellipsolites compressus*, J. Sowerby, Min. Conch. vol. i. p. 84, pl. xxxviii.
 1844. *Nautilus (Discites) mutabilis*, M'Coy, Synop. Carboniferous Foss. Ireland, p. 18, pl. iii. f. 7.
 1847. *Nautilus mutabilis*, d'Orbigny, Paléont. Universelle, vol. i. pl. lxxxviii. ff. 1-4.
 1849. *Nautilus mutabilis*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 110.
 1852. *Nautilus mutabilis*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 178.

1860. *Discites mutabilis*, Griffith, Journ. Geol. Soc. Dublin, vol. ix. p. 77.

1878. *Nautilus mutabilis*, de Koninck, Faune de Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. tom. ii.), pt. i. p. 121, pl. xxv. ff. 2 a, 2 b, 2 c.

Sp. Char. "Discoid, very much compressed; whorls five or six¹, entirely exposed, quadrangular, aperture sagittate; back very concave, less than one fourth the width of the side, umbilical slope as broad as the back, steep, concave, with an angular margin; two outer whorls in adult specimens perfectly smooth, inner ones marked with strong, equal, spiral sulci.

"The change of character of the surface from the inner to the outer whorls is even greater than in the *Nautilus (Discites) discors*, M'Coy, the inner volutions being spirally striated as in that species, but the outer turns being perfectly smooth; it differs from that species, besides the smoothness of the outer whorls, in the much more compressed form, long narrow mouth, and the narrow and very concave back; from the *N. (Discites) trochlea*, M'Coy, it differs in the striation of the inner whorls" (M'Coy.)

Remarks. In well-preserved specimens it is seen that the surface of the test in the adult is not perfectly smooth, as described by M'Coy, but that there are fine transverse lines which form a sigmoid curve upon the sides of the shell, and a backwardly directed sinus upon the periphery. The siphuncle is a little above the centre, and retains that position throughout the whole extent of the shell.

The outline of the aperture, which is of a sigmoid form with a rather deep peripheral sinus, is preserved in one of the specimens in the Collection². In approaching the aperture the body-chamber disengages itself from the coiled portion and continues for a greater or less distance in a larger curvature. In one specimen (No. 43867) the free portion is at a maximum distance of 8 lines from the coiled part.

There can be very little doubt that the *Ellipsolites compressus*, Sowerby, is identical with the present species, and therefore M'Coy's name must give place to the former. It is true that the specimens upon which Sowerby founded his species are in the worst possible state of preservation, the larger one being not only distorted, but badly eroded as well; yet the general characters—number and shape

¹ M'Coy overestimated the number of whorls, owing probably to his specimens having the inner ones covered by the matrix. There are not more than 3½, or 4 at the most.

² No. 1685 in the Register.

of whorls &c.—are those of M'Coy's species, and, moreover, there is no other species with which Sowerby's form could be confounded. Sowerby's description runs thus:—"Shell flat, smooth; margin broad, flat, perpendicular to the sides; volutions four or five, almost wholly exposed; aperture oblong rectangular."

To this he adds the following:—"Both sides are alike, the greater diameter is about one fourth longer than the lesser; the thickness about one fourth of the shorter diameter." It appears evident that Sowerby had before him, when he wrote his description, more perfect examples than those he figured.

M. de Koninck observed upon the similarity between the *N. compressus* of Sowerby and the *N. mutabilis* of M'Coy, and suggested that the former was a variety of the latter¹.

The *Nautilus Mosquensis* of Тзвѣтаев² (= *subsulcatus*, Trautschold (non Phill.)) somewhat resembles the present species, but the periphery is broader and not so concave, and the sutures are not so sinuous as in Sowerby's species.

Horizon. Carboniferous Limestone.

Localities. Naas and Rathfarnham, near Dublin, Kildare, Rathkeale (Co. Limerick), and near Cork.

Well represented in the Collection, which contains several very beautiful specimens, and includes Sowerby's types figured in the 'Mineral Conchology.'

Discites planotergatus, M'Coy.

- 1843. *Nautilus hexagonus*, de Koninck, Descrip. des Anim. Foss. du Terr. Carbonifère de la Belgique, pl. xxv. f. 1. (Not of J. Sowerby.)
- 1843. *Nautilus subsulcatus*, de Koninck, ibid. p. 548, pl. xxx. ff. 6 a, 6 b (excl. ff. 6 c, 6 d). (Not of J. Phillips.)
- 1844. *Nautilus (Discites) planotergatus*, M'Coy, Synop. Carboniferous Foss. Ireland, p. 18, pl. ii. f. 2 (three figures).
- 1849. *Nautilus planotergatus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 110.
- 1852. *Nautilus planotergatus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 177.
- 1860. *Discites planotergatus*, Griffith, Journ. Geol. Soc. Dublin, vol. ix. p. 56.
- 1878. *Nautilus planotergatus*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), p. 117, pl. xxvi. ff. 1, 2, 3 a, 3 b, 3 c.

¹ Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), 1878, pt. i. p. 122.

² Mémoires du Comité Géologique [Russia], vol. v. no. 3, 1888, p. 52.

Sp. Char. The following is M'Coy's description of the type specimen:—"Discoid, compressed, whorls quadrangular; sides flat, smooth; back flat, smooth, three fourths the width of the sides; inner whorls exposed, about five in number; septa simple, about half an inch apart.

"This fine species often reaches to ten inches in diameter; it is distinguished from the *N. complanatus*, Sow., by its very broad, flat back and simple septa; from the *N. discus*, Sow., by the broad, flat back and the greater spaces between the chambers; the *N. quadratus*, Flem., is distinguished by its striated surface. Diameter, four inches; width of last whorl, one and a half inches; breadth of back, one inch three lines." (*M'Coy.*)

The transverse section is nearly quadrate in the young shell, but becomes elongated in the adult, on account of the more rapid growth of the shell. The umbilicus has a small central perforation.

The septa are not very approximate, they number from twenty-one to twenty-five. The sutures make a rather deep backward curve on the sides of the shell, and a moderately deep sinus upon the periphery.

The body-chamber is rather large, and occupies nearly half of the last whorl.

The surface of the test is ornamented only with fine striæ of growth corresponding in direction with the outline of the aperture.

Remarks. This species was at first called *hexagonus* by de Koninck¹, but as that name had already been used by J. Sowerby (1837) for a Jurassic species, it had to be abandoned, and in the meantime M'Coy² had described it under the name of *planotergatus*, which it now bears.

D. planotergatus differs from *D. Leveilleanus* in its more rapid rate of increase and more angular whorls, and also in the absence of longitudinal ridges upon the test, which are a conspicuous feature in the ornamentation of the latter.

A specimen in the Collection, agreeing perfectly in its septal characters, and also in the position of the siphuncle with *D. planotergatus*, nevertheless differs from it in being a more compressed, thinner shell, and having much steeper sides to the umbilicus. This specimen (No. C. 1544) is a section cut through the centre of the whorls, and is from the Carboniferous Limestone of Derbyshire. It might perhaps be regarded as a compressed variety of *planotergatus*.

¹ Descrip. des Anim. Foss. du Terr. Carb. de la Belgique, pl. xxv. f. 1.

² Synop. Carb. Foss. Ireland, p. 18, pl. ii. f. 2.

Horizon. Carboniferous Limestone.

Locality. Not recorded, but most probably Ireland.

Represented in the Collection by a single example.

Discites sulcatus, J. de C. Sowerby, sp.

1826. *Nautilus sulcatus*, J. de C. Sowerby, Min. Conch. vol. vi. p. 137, pl. dlxxi. ff. 1, 2.

1836. *Nautilus sulcatus*, Phillips, Geol. of Yorkshire, pt. ii. p. 233, pl. xxii. ff. 31, 32.

1843. *Nautilus sulcatus*, Portlock, Geol. of Londonderry, p. 404.

1844. *Nautilus sulcatus*, de Koninck, Descrip. des Anim. Foss. du Terr. Carbonifère de la Belgique, p. 545, pl. xlvii. ff. 10, *a*, *b*.

1852. *Nautilus sulcatus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 175.

1854. *Nautilus sulcatus*, Morris, Cat. British Fossils, 2nd ed. p. 309.

1860. *Discites sulcatus*, Griffith, Journ. Geol. Soc. Dublin, p. 561.

? 1860. *Nautilus sulcatus*, F. A. Roemer, Beiträge zur geologisch. Kenntn. des nordwestl. Harzgebirges, Abth. iv. p. 167, Tab. xxvii. f. 3.

1876. *Nautilus (Discites) sulcatus*, Armstrong, Young, and Robertson, Cat. of Western Scottish Fossils, p. 59.

1878. *Nautilus sulcatus*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), p. 126, pl. xxvii. ff. 1-4.

Sp. Char. Shell discoid, compressed, composed of two and a half or three whorls only just touching each other, and all exposed in a rather shallow umbilicus, which has a large central perforation. The whorl in section is broadly sagittate, the periphery very narrow, concave, and bordered by sharp keels. The sides are inflated in the lower two thirds, with three or four fine spiral ridges or keels upon the prominent part, the lower keel forming the edge of the umbilicus. The upper third of the sides is divided by a narrow ridge into two deep sulci, which are not quite so wide as the peripheral groove. The surface of the test is covered by very fine lines of growth, which are curved sigmoidally upon the sides, and make a deep, backwardly directed sinus upon the periphery.

The body-chamber occupies about half of the last whorl.

The septa are tolerably numerous, about twenty-six in a complete whorl. The siphuncle is situated very near the peripheral margin.

Remarks. This species is nearly allied to *D. bisulcatus*, de Koninck, but differs from that species in having less compressed, transversely broader whorls, more strongly marked and persistent sulci on the sides, and more distant septa.

Horizon. Carboniferous Limestone.

Localities. Castleton, Derbyshire; Caldbeck, Cumberland.

Represented in the Collection by Sowerby's types ("Sowerby Collection") figured in the 'Mineral Conchology:' and other examples.

Discites bisulcatus, de Koninck, sp.¹.

1844. *Nautilus (Discites) sulcatus*, M'Coy, Synop. Carboniferous Foss. Ireland, p. 19, pl. iv. f. 14. (Not of J. de C. Sowerby.)

1855. *Nautilus (Discites) sulcatus*, M'Coy, in Sedgwick and M'Coy's British Pal. Foss. fasc. iii. p. 561. (Not of J. de C. Sowerby.)

1878. *Nautilus bisulcatus*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), p. 128, pl. xxvii. ff. 5, 6, 7, 9.

Sp. Char. Shell discoid, lenticular, compressed, composed of three whorls, all exposed in a somewhat shallow umbilicus, which has a large central perforation. The initial extremity is pointed, and no cicatrix has been seen upon it. The section is oval at the commencement of the first whorl, but it soon becomes polygonal, and preserves this form until within a short distance from the aperture. The latter is subtriangular, truncated above, and a little more than one-third higher than wide. The surface is ornamented on the sides with three small longitudinal keels, which are equidistant and parallel; the inside one forming the edge of the umbilicus is continued up to the aperture, whilst the other two become obsolete before the latter is reached. Besides the three keels just mentioned there is a fourth, situated in the upper third of the sides; it is sometimes double, and is only visible upon the last whorl, which covers it in the preceding whorls. On each side of this double keel is a rather shallow groove, the inner one of which only is seen throughout the whole extent of the whorls.

The surface is covered with fine and regular lines of growth forming a sigmoid curve upon the sides of the shell and a deep sinus upon the periphery.

The septa are numerous, there being thirty in the last whorl.

The body-chamber occupies about half of the last whorl.

The siphuncle is situated between the centre and the peripheral border.

Remarks. De Koninck pointed out the distinctness of this species from the *D. sulcatus* of J. de C. Sowerby, and the evidence of the specimens in the British Museum Collection fully justifies his views upon the subject. It appears that M'Coy had, in the earlier copies of the plates illustrative of his 'Synopsis,' called his species *bisul-*

¹ Not M'Coy, as de Koninck has it.

catus, but afterwards adopted Sowerby's name *sulcatus*, erasing the syllable *bi* in the plates of the later copies of his work. It is quite clear, however, that the name *bisulcatus* now belongs of right to de Koninck, McCoy having rejected it, and indeed it appears never to have been printed in the *text* of his "Synopsis," nor was it quoted by Griffith (as de Koninck himself says) in his lists of Irish Carboniferous Fossils¹.

Horizon. Calcaire Carbonifère Supérieur de Visé (Assise vi.), =Carboniferous Limestone.

Localities. British. Craven, Yorkshire; Hesket Newmarket, Cumberland.—*Foreign.* Visé, Belgium.

Represented in the Collection by several imperfect specimens.

Discites ? involvens, Salter, sp.

1865. *Nautilus ? involvens*, Salter, in Palæontology of Niti in the Northern Himalaya, being Descriptions and Figures by J. W. Salter and H. F. Blanford of the Palæozoic and Secondary Fossils collected by Colonel R. Strachey, R.E., p. 12, pl. ii. f. 3.

Sp. Char. "N. involutus, compressus, anfractibus 3 latis, ad umbilicum parvum valdè rotundatis, lateribus planis, angulis externis obtusis, dorso plano. Septa obliqua conferta, lente curva, nisi ad umbilicum abruptè flexa.

"The name *Nautilus* is retained for this obscure fossil rather as an indication of its possibly belonging to a newer set of rocks [than Silurian]. It is too involute and Nautiloid for any Silurian *Lituites* or allied genus known to me, but is not unlike some of the species of *Discites*, a subgenus of *Nautilus* common in Carboniferous strata.

"Our specimen has a diameter of $2\frac{1}{4}$ inches, and has three compressed whorls—perhaps a minute fourth. The outer whorl is nearly four times as wide as the next succeeding, and is swelled and abruptly rounded near the umbilicus, then flat on the sides, and bluntly angular between these and the back. This is flat, and has a greater width than our crushed specimen would at first indicate. . . . The surface is destroyed.

"The septa are very oblique forwards, bent sharply over the umbilical slope, then sweeping forward in a low curve over the

¹ "Notice respecting the Fossils of the Mountain Limestone of Ireland as compared with those of Great Britain, and also with the Devonian System," 1842, p. 20.

flattened sides, and nearly direct across the back. They are closely placed, very much as in the Carboniferous species." (Salter.)

Horizon. Uncertain.

Locality. Gunesgunga; in a boulder.

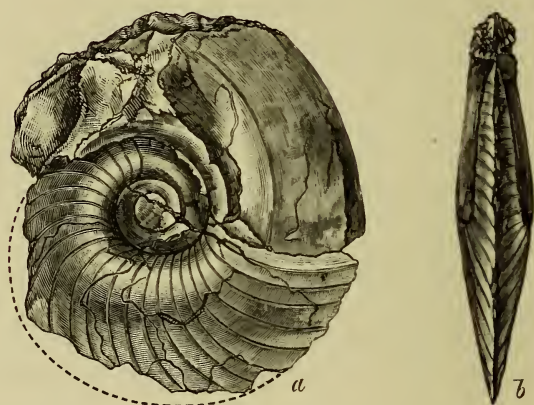
Represented in the Collection by the type specimen described and figured by J. W. Salter.

Subgenus **PHACOCERAS**, Hyatt¹.

(*Nautili Lenticulares*, de Koninck, 1878².)

This subgenus differs from *Discites* in its lenticular, highly compressed form and acute periphery. The young are longitudinally

Fig. 12.



Discites (*Phacoceras*) *oxystomus*.—*a*, lateral view of an imperfect specimen, showing the septate part of the shell and a portion of the body-chamber; the latter begins at the deep notch on the right of the figure: *b*, front view, showing the lenticular form of the shell and the extremely sharp periphery. Drawn from a specimen in the Collection. About two-thirds of the natural size.

dged like *Discites*. The whorls are deeply embracing, and there is a very strongly impressed zone of involution upon the dorsal side. Type, *Nautilus oxystomus*, Phillips.

Carboniferous.

¹ Proc. Boston Soc. Nat. Hist. 1883, vol. xxii. p. 292.

² Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), pt. i. p. 90.

Discites (Phacoceras) oxystomus, Phillips, sp.

1836. *Nautilus oxystomus*, Phillips, Geol. of Yorkshire, pt. ii. p. 233, pl. xxii. ff. 35, 36. (Not of H. Trautschold ¹.)
1843. *Nautilus oxystomus*, de Koninck, Descrip. des Anim. Foss. du Terr. Carb. de la Belgique, p. 544, pl. xlix. ff. 3, a, b.
1844. *Nautilus (Discites) oxystomus*, M'Coy, Synop. of the Carboniferous Foss. Ireland, p. 18.
1847. *Nautilus oxystomus*, d'Orbigny, Paléont. Universelle, vol. i. pl. cv. ff. 3, 4.
1849. *Nautilus oxystomus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 111.
1854. *Nautilus oxystomus*, Morris, Cat. British Foss. p. 308.
1855. *Nautilus oxystomus*, M'Coy, British Pal. Foss. fasc. iii. p. 560.
1860. *Discites oxystomus*, Griffith, Journ. Geol. Soc. Dublin, vol. ix. p. 33.
1878. *Nautilus oxystomus*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), pt. i. p. 123, pl. xvii. ff. 3 a, 3 b.
1883. *Phacoceras oxystomum*, Hyatt, "Genera of Fossil Cephalopods," Proc. Boston Soc. Nat. Hist. vol. xxii. p. 293.

Sp. Char. "Lenticular, very much compressed laterally; greatest thickness at the edge of the small shallow umbilicus, from whence the sides slope, almost flatly, to the thin, very acutely carinated periphery; whorls about four, their edges distinctly visible in the umbilicus; the mouth very elongate, lanceolate, embracing three-fourths of the sides of the penultimate whorl. Surface of inner whorl spirally sulcated, of the outer turns smooth, or with extremely fine, obsolete transverse lines of growth, having a very strong forward wave in the middle, and a small, slightly marked one at the sloping edge of the umbilicus. Internal casts show the septa strongly arching forwards from the umbilicus to a flat, solid band, about two or three lines wide, produced by the internal cavity not quite reaching the edge; the last chamber occupies rather less than half the last whorl, and is marked by a narrow, deep sulcus, a little on the inner side of the middle, produced apparently by a corresponding ridge on the interior of the shell, of which there is no trace on the outside.

"I have not been able to observe the siphuncle in this species, but according to de Koninck it is very small and nearly central, a little outside of the middle. The inner whorl is scarcely embraced by the succeeding one, is not compressed, and has a broad, convex

¹ Nouveaux Mémoires de la Soc. Imp. des Nat. de Moscou, tom. xiii. p. 304, pl. xxx. f. 7.

periphery; the next has a much more acute periphery, and is correspondingly embraced by the succeeding turn." (*M^cCoy.*)

Remarks. It will be seen that the whorls in the young of this species are, as already pointed out by Professor Hyatt, similar to the adult of *Discites* both in form and ornamentation. The lenticular form of the whorl recalls also the *Nautilus discus* of Sowerby.

There is no species with which the present one is strictly comparable.

Horizon. Carboniferous Limestone.

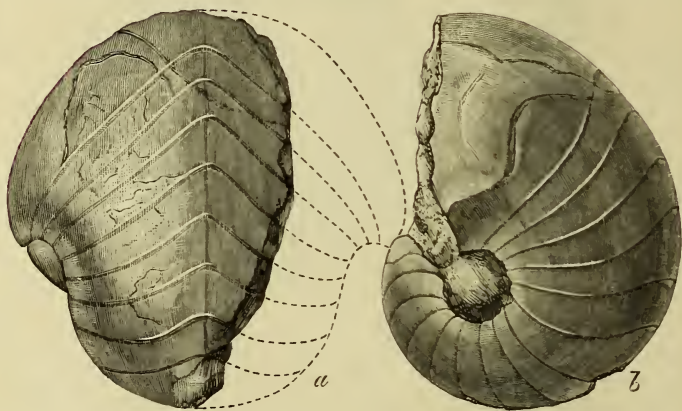
Locality. Unknown.

Represented in the Collection by a single example, contained in the "Gilbertson Collection."

Genus **EPHIPPIOCERAS**¹, Hyatt².

(*Nautilus* (pars), auctorum.)

Fig. 13.



Ephippioceras clitellarium.—*a*, ventral or peripheral view of a cast, showing the septa and the faint median line; the dotted lines are added to indicate the form of the shell when perfect: *b*, lateral view of the same fragment. Drawn from a specimen in the Collection. Natural size.

Gen. Char. Shell *Nautilus*-like, globose, rapidly enlarging, very slightly umbilicated, if at all. Septa forming a very acute angle upon the periphery, so that they divide the shell into two elliptical

¹ From ἐπίππιον, a saddle.

² Proc. Boston Soc. Nat. Hist. 1883, vol. xxii. p. 290.

lobes. Siphuncle nearly central. Surface of the test marked only with lines of growth. Type, *Nautilus ferratus*, Cox¹.

Carboniferous.

Remarks. Hyatt observes that "in the American species, and perhaps in all, there is a slight dorsal saddle in the centre" of the shallow dorsal lobe. Only four species of this singular form are known, viz. *Nautilus bilobatus*, J. Sowerby, *N. clitellarius*, J. de Carle Sowerby, *N. ferratus*, Cox, and *E. costatum*, Foord.

Ephippioceras bilobatum, J. Sowerby, sp.

1819. *Nautilus bilobatus*, J. Sowerby, Min. Conch. vol. iii. p. 89, pl. ccxlix. ff. 2, 3.

1883. *Ephippioceras bilobatum*, Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 290.

Sp. Char. "A nearly globose shell, with the front [periphery] a little flattened, the umbilicus is small and nearly cylindrical; the siphuncle is central, on each side of it the septa are remarkably concave, so as to form two elliptical lobes. It is nearly as thick as wide." (*Sowerby.*)

Remarks. This species is closely allied to *E. clitellarium*, J. de C. Sowerby, but is clearly distinguished from it by its more flattened and much less expanded sides, and consequently less rapid rate of increase, and by the greater height of the whorls in proportion to their width.

Horizon. Calciferous Sandstone.

Locality. Closeburn, Dumfriesshire.

Represented in the Collection by the type specimens figured in the 'Mineral Conchology.'

Ephippioceras clitellarium, J. de C. Sowerby, sp.

[See Fig. 13.]

1836. *Nautilus bilobatus*, Phillips, Geol. of Yorkshire, pt. ii. p. 232.

1840. *Nautilus clitellarius*, J. de C. Sowerby, Trans. Geol. Soc. vol. v. pt. iii. Explanation of the plates, &c. pl. xl. ff. 5, 5 a, 5 b.

? 1845. *Nautilus clitellarius*, de Verneuil, in Murchison, de Verneuil, and de Keyserling's Géol. de la Russie d'Europe, vol. ii. pt. iii. p. 365, pl. xxv. ff. 11, a-d.

? 1848. *Goniatites ovoideus*, Fischer de Waldheim, Bull. Soc. Imp. des Naturalistes de Moscou, no. iii. p. 132, pl. v. f. 3.

? 1848. *Cyrtoceras Fahrenkohlü*, Fischer de Waldheim, ibid. p. 128, pl. v. f. 1.

¹ Third Report of the Geol. Surv. of Kentucky, 1857, p. 574, pl. x. ff. 2, 2 a.

1849. *Nautilus bilobatus* (pars), d'Orbigny, Prodr. de Paléont. Stratigr. vol. i.
1852. *Nautilus bilobatus* (pars), Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 167.
1854. *Nautilus bilobatus* (pars), Morris, Cat. of British Fossils, 2nd ed. p. 307.
1855. *Nautilus bilobatus*, M'Coy, British Palæozoic Fossils, fasc. iii. p. 556.
- ? 1857. *Nautilus ferratus*, Cox, in D. D. Owen's Third Report of the Geol. Surv. in Kentucky, for the years 1856 and 1857, vol. iii. p. 574, pl. x. ff. 2, 2 a.
1860. *Nautilus clitellarius* (pars), Eichwald, Lethæa Rossica, Seconde Section de l'ancienne Période, vol. i. p. 1317.
1861. *Nautilus bilobatus*, F. Roemer,* Zeitschr. der Deutsch. geol. Gesell. Band xiii. p. 695, Taf. xviii. ff. 1, 2.
1874. *Nautilus clitellarius*, Trautschold, Nouv. Mém. Soc. Imp. des Naturalistes de Moscou, vol. xiii. p. 302, pl. xxx. f. 4.
1878. *Nautilus bilobatus*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), p. 92, pl. ix. ff. 1, a-c.
1883. *Ephippioceras clitellarium*, Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 290.
1888. *Nautilus bilobatus*, Tzwetaev, Céphalopodes de la Section supérieure du Calc. Carb. de la Russie Centrale (Mémoires du Comité Géologique [St. Pétersbourg], vol. v. no. 3), p. 54, pl. v. ff. 23, 24.

Sp. Char. "Globose; of two to three very rapidly enlarging whorls; mouth very broad, transversely reniform, obtusely rounded at the sides; greatest width of the shell at the edge of the umbilicus; periphery broadly rounded, with a nearly semicircular section, very slightly flattened at the middle; umbilicus small, very deep, exposing about a third of the inner turns; surface of the inner whorls marked with fine spiral striæ, crossed by very fine transverse striæ of growth (the spiral striæ seem to disappear on the large specimens); septa very numerous, about two lines apart in the middle, at an inch and a half in width, one line apart at five lines in width, their edges extending from the umbilicus towards the periphery, with a broad slight curve, the convexity backwards; on reaching the middle third of the periphery they abruptly bend forward with a tongue-shaped semielliptical curve, extending so far forwards that a straight line, extending from the septum at the middle of the periphery to the umbilical edge of the same septum, would touch the middle of the following septal edge; internal surface of each septum divided into two deep, rounded hemispherical pits, one on each side, separated by a narrow, very prominent,

rounded elevation, extending from the tongue-shaped sinus of the outer margin to the opposite point of the inner margin, nearly in the middle of which elevation is the very large siphuncle . . . ” (M'Coy.)

Remarks. This species has been held by de Koninck and M'Coy to be identical with *E. bilobatum*, J. Sow.; but a careful comparison of the two species will, I think, convince any one that there are differences between them quite sufficient to warrant their separation. Unfortunately J. Sowerby gave but one figure of the type specimen, and that a little foreshortened, therefore its characters were not all displayed. On comparing the type of *E. bilobatum* with a specimen of *E. clitellarium*, it is at once apparent that the latter is a much broader and more rapidly expanding shell than the former. The whorls also in *E. clitellarium* are considerably higher in proportion to their width than those of *E. bilobatum*. These differences appear fully to justify the retention of the two names.

Authorities differ as to the identity of de Verneuil's *N. clitellarius* with the present species; M'Coy thinks they are the same; while de Koninck regards the *clitellarius* of de Verneuil as a distinct species, stating that its umbilicus is larger than that of the *bilobatus* of Sowerby, and also that its general form is less globular than the latter.

The *Nautilus ferratus* of Cox resembles *bilobatus* so very closely that the former can be scarcely more than a variety of the latter; the American form occurs also at the same horizon as the English one; and under similar mineral conditions, both being associated with iron in the beds in which they are found.

Horizon. Coal-Measures.

Localities. Madeley, Coalbrookdale, Shropshire: Martley, Worcestershire.

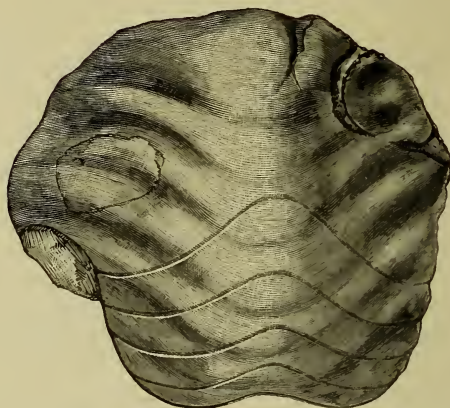
Well represented in the Collection.

Ephippioceras costatum, Foord.

Sp. Char. This species is distinguished from *E. clitellarium* (to which it is, however, very closely related) by the character of the septa and by the surface ornaments. The septa in *E. costatum* do not form such an acute lobe upon the periphery as do those of *E. clitellarium*, and they are also a little wider apart in the former species than they are in the latter. Moreover, *E. costatum* is provided with prominent transverse costæ which are strongest upon the sides of the shell, where they swell out into heavy folds. These

costæ are directed obliquely backwards, and cross the septa at an acute angle, passing across the periphery and forming a shallow sinus in the middle. None of the specimens in the British-Museum Collection have the test preserved, so that the ribbing has only been observed upon casts. The costæ are equally well developed upon the body-chamber and upon the septate part of the shell in the adult, but they were either very feeble or altogether absent in the young.

Fig. 14.



Ephippioceras costatum.—Ventral or peripheral view of a cast showing the coarse ribbing, some of the septa, and the greater part of the body-chamber. Drawn from a specimen in the Collection. Natural size.

Remarks. It is due to my friend Mr. G. C. Crick to observe that it was he who pointed out to me the costate character of the surface of this species, which I had overlooked. Indeed, the costæ are more easily felt than seen, and unless the specimens are held in a certain direction as to the light these ornaments might very easily escape attention. In the drawing they naturally appear plainer than in the specimens, though their prominence has not been exaggerated in the slightest degree.

The difference between this species and *E. clitellarium* has already been pointed out, but it may be added that the latter has a broader periphery than *E. costatum*.

Horizon. Coal-Measures.

Localities. Madeley, Coalbrookdale, Shropshire; Martley, Worcestershire.

Well represented in the Collection.

Genus **CÆLONAUTILUS**¹, Foord.

(*Vestinautilus*, Ryckholt²; *Trematodiscus*, Meek and Worthen³; *Nautili Sulciferi*, *Nautili Cariniferi* (pars), de Koninck⁴; *Phloioceras*, Hyatt⁵; *Trematoceras*, Hyatt⁶.)

Gen. Char. Shell thick, discoid, with wide, very deep umbilicus, exposing all the volutions; a central perforation is always present, and is very large in some species, as, for example, *C. Meyerianus*, de Kon. Volutions much wider than high, increasing rather rapidly, very slightly embracing, provided with more or less numerous angles or carinæ. Periphery convex, very broad, sometimes having, especially in adult specimens, a wide, shallow depression in the median line. Sutures nearly straight, except in passing over the periphery, where they make a more or less deep sinus. A dorsal (internal) lobe is present.

Type, *Nautilus stygialis*, de Koninck⁷.

Carboniferous to Trias.

¹ This name, from *καὶλον*, hollow (referring to the umbilicus), and *Nautilus*, is substituted for *Trematodiscus*, Meek and Worthen, which was used by Häckel for a genus of Radiolarians. The name *Trematoceras*, proposed by Hyatt in lieu of *Trematodiscus*, is equally ineligible, because preoccupied, for although the species described by Eichwald (Leth. Ross. 1860, vol. i. p. 1259) — *Trematoceras discors* — is a *Bactrites*, a generic name once used cannot be again employed, even for a different genus, without risk of confusion. The recommendations of the British Association on this point are explicit, as follows:—"Classes of objectionable names"—*g*. "Some authors consider that when a name has been reduced to a synonym by the operation of the laws of priority, they are at liberty to apply it at pleasure to any new group which may be in want of a name. We consider, however, that when a word has once been proposed in a given sense, and has afterwards sunk into a synonym, it is far better to lay it aside for ever than to run the risk of making confusion by re-issuing it with a new meaning attached." (From the British Association 'Rules of Zoological Nomenclature,' revised at the Birmingham Meeting, September 1865 (pub. 1866), p. 40.)

² Notice sur les Genres *Nautilus*, *Vestinautilus*, *Asymptoceras*, &c. (pamphlet, 1852), p. 4. Also Hyatt, Proc. Boston Soc. Nat. Hist. 1883, vol. xxii. p. 294.

³ Proc. Acad. Nat. Sci. Philadelphia, 1861, p. 147. Geol. Surv. of Illinois, Palæont. vol. ii. 1866, p. 161. Report of the United States Geol. Surv. of the Territories, 1876, vol. ix. p. 491.

⁴ Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), pt. i. p. 90.

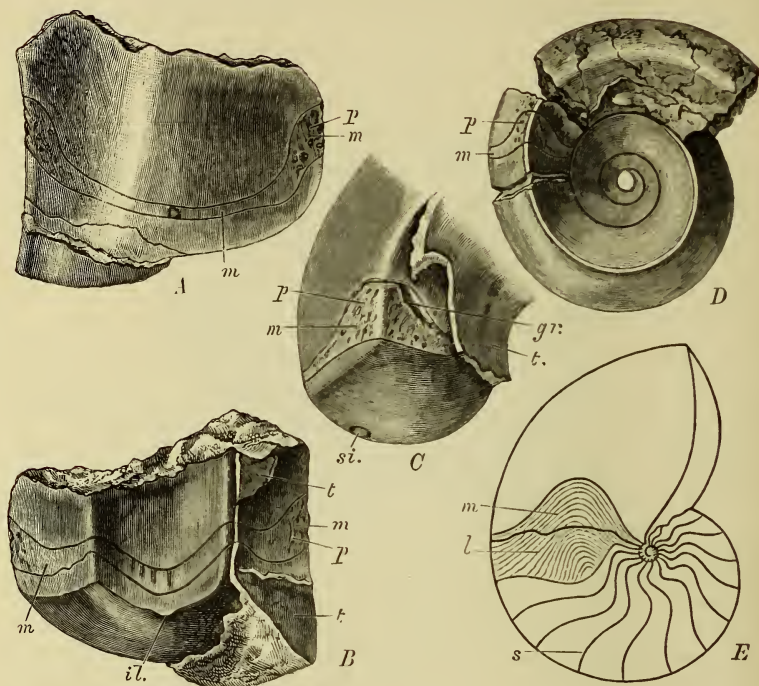
⁵ Proc. Boston Soc. Nat. Hist. 1883, vol. xxii. p. 286.

⁶ Ibid. p. 291 (footnote).

⁷ Descrip. des Anim. Foss. du Terr. Carbonif. de Belgique, p. 547, pl. xlv. ff. 11, *a*, *b*.

Remarks. The following particulars regarding the history and affinities of the present genus are taken from the writings of Messrs. Meek and Worthen¹:—"Although in some respects analogous to *Discites*, M'Coy, these shells differ from the typical forms of

Fig. 15.



Calonautilus cariniferus, J. de C. Sowerby, sp., from the Carboniferous Limestone, Cork, Ireland.—*A.* Ventral or peripheral aspect of the base of the body-chamber (nat. size), showing at *m*, *m*, marks of the shell-muscles (*m* in all the other figures has the same meaning); *p*, in all the figures (exclusive of *E*) refers to the pitted and rugose surface of the muscular impressions. *B.* Dorsal (internal) aspect of the same fragment: *t*, test; *il*, dorsal lobe of a septum. *C.* Base of the body-chamber of a larger (? adult) specimen: *t*, test; *gr*, groove. *D.* Reduced figure of a nearly perfect example of this species, from which the fragment lettered *A* and *B* was removed, as explained elsewhere in the text. *E.* Outline, much reduced in size, drawn from a cast of the interior of *Nautilus pompilius*: *l*, finely impressed lines left by the shell-muscle; *s*, sutures of the septa.

¹ Geol. Surv. of Illinois, Paleont. vol. ii. 1866, p. 161.

that group in having a perforated umbilicus¹; while the whorls are less compressed, narrower [*i. e.* laterally], and provided with several distinct revolving angles and grooves. They also differ in being often ornamented with well-defined revolving lines. In the perforated character of the umbilicus the shells of this group may not differ from some other sections of discoid fossil *Nautili*, but in the possession of several distinct revolving grooves and angles, with strong longitudinal striæ, they seem to be quite peculiar. The group appears to be mainly, if not almost exclusively, confined to the Carboniferous System, and will include the following foreign species:—*Nautilus stygialis*, *N. Edwardsianus*, *N. Omalianus*, and *N. pinguis*, de Koninck [not *N. pinguis*, M'Coy], together with *N. sulcatus*, *N. cariniferus*, &c. of [J. de C.] Sowerby².

"After proposing the foregoing name [*Trematodiscus*] and description for this ancient group of *Nautili*, we observed that Prof. M'Coy had proposed, in his 'Carboniferous Fossils of Ireland,' p. 20, 1844, the name *Temnocheilus* for a group of Carboniferous species, including some of the same species for which our name *Trematodiscus* was proposed. As his subgenus, however, embraced a much wider diversity of forms than ours, it may be found convenient to restrict it to such types as his first species *N. biangulatus*, *N. pinguis* (M'Coy, not de Kon.), and *N. globatus* . . ." These species are now, however, included in the present genus.

The name *Vestinautilus*, which is here treated as a synonym, was proposed by Ryckholt in the pamphlet already cited, and which appears to have had a very limited circulation. *Vestinautilus* is referred to by de Koninck in his able review of the literature of the *Nautilidæ*³. After describing the features in Ryckholt's fossils, upon which that author based his genus, de Koninck points out that the latter cannot be recognized, as it was evidently founded upon an error of observation, Ryckholt believing that he recognized in one of the layers of the test a character of sufficient importance for classificatory purposes. Professor Hyatt retains the name *Vestinautilus* for the shells comprised in the present group which he redescribes, but as Ryckholt's name cannot be used in the sense intended by its author, it is better that it should be suppressed altogether.

¹ This is an error, caused probably by M'Coy's figure of *Discites planotergatus* (type of the genus) being represented with a closed umbilicus; it is really open, both in this and in other species of the group.

² Some of these can no longer be included in the present genus.

³ Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), 1878, pt. i. p. 86.

"The typical forms of this genus are distinguished by the widely umbilicated, slightly embracing whorls, and by the peripheral and lateral longitudinal sculpture. This sculpture consists either of simple longitudinal ribs, or they may be nodose or crenulated. In a number of Carboniferous forms the ornaments become obsolete in the adult age, approaching thereby the closely-allied genus *Pleuro-nautilus*.

"The Triassic forms agree in part (*Trematodiscus gemmatus*) with the Carboniferous primitive form, and in part they deviate from this type in the disappearance of the lateral sculpture.

"The majority of Carboniferous forms have simple, straight septa. In the Triassic forms a flat external, and a flat but broader lateral lobe is present. In the majority of the Carboniferous forms an internal lobe is wanting. It is found, however, in *Nautilus cariniferus*, de Koninck (*non* Sowerby), and in *Gyroceras binodosum*, according to Sandberger¹.

"In the Triassic forms the occurrence of an internal lobe has been shown in *T. gemmatus*² and *T. rectangularis*³.

"There can hardly be any doubt about the origin of the genus *Trematodiscus* if one compares the figures of *Gyroceras consobrinum*, *G. intermedium*, *G. propinquum*, *G. tessellatum*, and *G. serratum* in de Koninck's fine Monograph⁴ with those of the *Trematodisci* contained in the same work on pls. xxvii.-xxx.⁵ These two series of forms are only distinguished by the different amount of the enveloping of their whorls. As de Koninck himself has justly observed, it is impossible to distinguish the first whorl of *Trematodiscus* from that of a *Gyroceras* belonging to the series above enumerated. To these also manifestly belong the slightly curved forms that de Koninck has described [Calc. Carb. pl. xxxiii.] under the names *Cyrtoceras canaliculatum*, *C. Puzosianum*, and *C. Gesneri*." (*Mojsisovics*.)

The species belonging to the present genus recorded by Mojsisovics⁶ are the following:—*Trematodiscus* [*Cælonautilus*] *rectangularis*, F. von Hauer⁷, *T. [C.] Klipsteini*, Mojs., and *T. [C.] gemmatus*, Mojs.

In examining the remarkably fine series of examples of *Cælonautilus cariniferus*, mostly from the Carboniferous Limestone of

¹ It is present also in *Discites discors*, M'Coy.

² Das Gebirge um Hallstatt, 1873, Theil i. pl. iii.

³ Die Cephalopoden der Mediterranen Triasprovinz, 1882, pl. lxxxvii.

⁴ Faune du Calc. Carb. de la Belgique, 1880, pl. xxxiii.

⁵ Ibid. 1878.

⁶ Die Cephalopoden der Mediterranen Triasprovinz, 1882, p. 270.

⁷ Denkschr. d. k.-k. Akad. d. Wiss. zu Wien, Band ix. p. 145, Taf. i. ff. 1-4.

Ireland, some were found to exhibit upon the cast of the body-chamber distinct marks of the shell-muscles. In one specimen (No. 50190) these are so perfect as to give a very clear outline of their form; and some of the test having been removed, their entire course can be made out.

Fig. 15 (*A, B, D*) shows the appearance of these muscular impressions, carefully drawn, from this specimen.

A drawing has also been made (fig. *E*), much reduced in size, from a cast of the interior of the shell of *Nautilus pompilius*, in order that the muscular impressions of *C. cariniferus* might be compared with those of existing species of *Nautilus*.

Fig. *D* represents the specimen selected for illustration, it is reduced in size from the original about one half. The portion marked with the letters *p, m* was removed from the rest of the shell in order that the muscular impressions might be drawn as seen in figs. *A* and *B*, which are of the actual size.

Fig. *C* is taken from a larger (probably adult) specimen of *C. cariniferus* ("Sowerby Collection," No. 43861), and shows the marks of the shell-muscle on one of the angles of the whorl more distinctly than they can be seen on the smaller one.

A more detailed description of the figures may now be given. Fig. *A* represents the ventral or peripheral side of the base of the body-chamber. The impressions of part of the shell-muscles are seen at *m, m*, while *p* indicates their rugose and pitted surface, showing how strongly they were attached at the angles of the whorls; this is further evidenced by the deep groove *gr.* in fig. *C*.

Connecting the broader portions of the muscular impressions is a narrow band, near the centre of which is a little shallow pit (fig. *A*), which undoubtedly formed part of the muscular system, as the narrow band is slightly enlarged at this point to embrace it¹.

Fig. *B* is the underside of *A*. On this side it will be seen that the narrow band at its central part is strongly deflected backwards, in a similar manner to that of the annulus of the recent *Nautilus* (*N. pompilius*), so well figured (pl. xxxix. fig. 4) by Dr. W. Waagen in his well-known memoir entitled "Ueber die Ansatzstelle der Haftmuskeln beim Nautilus und den Ammoniden"².

The deflected portion bears several shallow, more or less elongated pits, which seem to indicate a rather strong attachment of the muscles at this point, though not so strong as at the angles of the whorls, where the muscular impressions are broadest.

¹ This enlargement is not indicated in the figure, as it should have been.

² Palæontographica, Bd. xvii. 1870, p. 185, pls. xxxix. & xl.

Fig. *C* represents the base of the body-chamber of a larger specimen than that from which *A* and *B* were drawn, and is designed to show more distinctly the pitted and rugose surface of the cast, proving, as already remarked, the strong attachment of the muscles at the angles of the whorl. Part of the test (*t*) has been removed in order to expose this part of the muscular impression more completely.

On examining the interior of the body-chamber of the shell of the recent *Nautilus* (either *N. pompilius* or *N. umbilicatus*) two somewhat inconspicuous lines (fig. *E, m*) are observed, enclosing a space which on the dorsal and ventral sides of the shell forms a narrow band,—the impression of the annulus,—but expands at each side into an irregularly oval space,—the impression of the shell-muscle,—of which the outer boundary is strongly arched forwards. Corresponding in direction with the line forming the outer boundary, and covering the whole of the space between this and the last-formed septum, are a series of very fine impressed lines (marked *l* in the fig.). These lines indicate successive points of attachment of the upper edge of the shell-muscle, representing a gradual forward movement, little by little, of the animal in its shell during growth. It should be observed that the irregular thick line constituting the lower boundary of the muscular impression is only seen where the muscle was last attached.

That the organic attachment of the shell-muscles of the recent *Nautilus* to the shell was very slight (thus contrasting strongly with *Cælonautilus*) has been pointed out by J. D. Macdonald¹ and subsequent writers². Macdonald describes very graphically what he conceives to be the mode of action of these “great lateral muscles” as he terms them:—

“As though preparatory to the complete separation of the body of the Cephalopod from the shell, which is usually present in the lower genera, the fasciculi composing the lateral muscles in *Nautilus* do not perforate the mantle, and therefore cannot be directly fixed into the shell; they are, however, connected with it through the medium of thin filmy layers of a corneous texture, which frequently remain attached to the shell after the animal has been removed. The feeble hold of those muscles, even in a very recent state, is thus readily accounted for. Indeed, it is highly probable that the

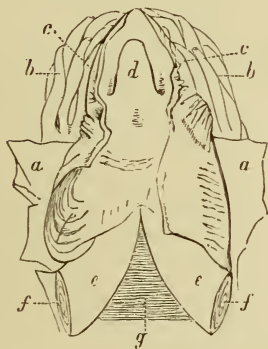
¹ Proc. Roy. Soc. 1856-7, vol. viii. p. 381.

² Prof. Blake, Brit. Foss. Ceph. pt. i. p. 10; see also “Note on the Pearly *Nautilus*,” by E. A. Smith, F.Z.S., in ‘Journ. of Conchology’ for Oct. 1887 also ‘Catalogue Fossil Cephalopoda,’ British Museum (Nat. Hist.), pt. i. 1888, p. xi.

fixity of the body of *Nautilus* during the inhalation and forcible ejection of the respiratory currents is effected by the shell-muscles reacting upon one another, on the principle of a spring-purchase, rather than by simple traction, as illustrated by the withdrawal of a Gasteropod within its retreat, or the closure of a Conchifer by the adductor muscles.

"This view, which is supported by the foregoing facts, has its principal basis in the line of direction of the shell-muscles, and the angle at which they meet one another, at the root of the funnel-lobe; for, the outer extremity of each being fixed, it follows that the first effect of the contraction of the muscular fibres would be to increase the angle just noticed; and this cannot possibly be accomplished, according to the recognized laws of muscular action, without tending to throw apart the points of origin, or, in other words, exerting outward pressure against the internal wall of the shell, and thus, as it were, jamming the occupant tightly in its cell."

In order that the above description may be more readily comprehended, a reduced copy of the figure given by Sir Richard Owen in his 'Memoir on the Pearly *Nautilus*' (1832, plate iii. fig. 2) is here appended.



Under surface of the head of *Nautilus pompilius*, with the mantle divided and the funnel turned back to expose its cavity and the shell-muscles.

a, a, the divided portions of the mantle; *b, b*, sheaths of the tentacles; *c, c*, the funnel; *d*, its valve; *e, e*, shell-muscles; *f, f*, their terminations or surfaces of attachment; *g*, the transverse fibres connecting them.

A comparison of the muscular impressions of *Cælonautilus* with those of the recent *Nautilus* points to the conclusion that the animal must in the former have been fixed more firmly in its shell than in the latter, and furthermore the shell-muscles in *Cælonautilus* were in all probability not limited to the sides of the animal, as in the recent *Nautilus*, but completely encircled it.

The difference between the shell-muscles of *Cœlonautilus* and those of the recent *Nautilus* strongly supports the view that the two forms are *generically* distinct, a conclusion already arrived at from the great dissimilarity in the form of their shells by such an eminent authority as Prof. Hyatt. The subdivision of *Nautilus*, as is well known, was begun long ago by M'Coy¹ and continued by Meek², the latter of whom expressed his decided opinion that such divisions should rank at least as distinct subgenera.

***Cœlonautilus cariniferus*, J. de C. Sowerby, sp.**

1825. *Nautilus cariniferus*, J. de C. Sowerby, Min. Conch. vol. v. p. 130, tab. cccclxxxii. f. 3 (excl. f. 4).
 ? 1825. *Nautilus biangulatus*, J. de C. Sowerby, Min. Conch. vol. v. p. 84, tab. cccclviii. f. 2 (two figs.).
 1828. *Nautilus excavatus*, Fleming, Hist. of British Animals, p. 231.
 1836. *Nautilus cariniferus*, Phillips, Geology of Yorkshire, pt. ii. p. 232, pl. xvii. f. 19.
 1836. *Nautilus sulciferus*, Phillips, *ibid.* p. 232.
 1844. *Nautilus (Tennocœilus) cariniferus*, M'Coy, Synop. Carboniferous Foss. Ireland, p. 20.
 1855. *Nautilus cariniferus*, M'Coy, British Pal. Foss. fasc. iii. p. 557.
 1889. *Cœlonautilus cariniferus*, Foord and G. C. Crick, Geol. Mag. dec. iii. vol. vi. p. 494, figs. A-E³.
 [Not 1844. *Nautilus cariniferus*, de Koninck, Descrip. des Anim. Foss. du Terr. Carbonifère de Belgique, p. 549, pl. xlviii. ff. 11, a, b, & 12.
 1878. *Ibid.*, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), p. 134, pl. xxviii. ff. 1-5.]

Sp. Char. "Discoid, subglobose; inner whorls half exposed in a large umbilicus; a keel in the middle of each side, and two ridges between it and the flattened front." (*Sowerby.*)

Remarks. The single prominent keel or ridge upon the edge of the umbilicus distinguishes this species from *C. paucicarinatus*, in which there is another keel just inside the umbilical hollow. The septa in the present species are very slightly sinuous upon the sides and periphery; their distance from each other increases slowly with the growth of the shell. In the adult they are 4 lines apart upon the sides, where the dorso-ventral diameter is 14 lines. The siphuncle is large, and is situated a little above the centre.

¹ Synopsis of the Carboniferous Limestone Fossils of Ireland, 1844.

² United States Geol. Survey of the Territories, 1876, vol. ix. p. 490.

³ The foregoing remarks on the shell-muscles of *Cœlonautilus* (pp. 109-112) are reprinted from this paper.

The whorls are all exposed, with a small central perforation: they are roughly hexagonal in section, the periphery in the young and adolescent stages of growth being bordered by an acute keel, which disappears in the adult. Two very obtuse keels or prominences are developed on the periphery, but these are scarcely perceptible in full-grown individuals, save that in some specimens their presence is indicated by a more or less distinct furrow along the median line¹. The body-chamber occupies about half a revolution, its aperture forming a sigmoid curve at the sides and a deep sinus upon the periphery. The surface of the test when well preserved is seen to be marked with fine striæ, of which four or five occupy the space of a line. The surface of the internal cast of the body-chamber is marked by a series of punctures arranged in lines which conform to the outline of the aperture, at the margin of which there are a number of crenulations which may indicate corresponding folds on the borders of the mantle, the punctures doubtless representing its surface.

A little above the base of the body-chamber the impression of the retractor muscle is seen upon the casts of well-preserved specimens. This is particularly well shown in a specimen from Ireland, registered No. 50190 (fig. 15, *D*), and also in No. 43861 (fig. 15, *C*), the latter forming part of the "Sowerby Collection."

Sowerby observes that "the lesser keels in *N. cariniferus* disappear as it advances in growth; it may possibly therefore be only a variety of *N. biangulatus*: the specimens with keels are, however, much larger than the specimen figured."

Not having seen the type specimen of *N. biangulatus*, I am unable to say anything definite about its affinities with the present species, but judging by Sowerby's figure I should suppose that it might be only an immature example of it.

Figure 4 (of Sowerby's plate cccclxxxii.) I take to be a fragment of *C. paucicarinatus*; but the specimen not being now in the "Sowerby Collection," I have no means of verifying this impression.

Horizon. Carboniferous Limestone.

Localities. Cork, Kildare, Rathkeale (Co. Limerick); Bolland, Yorkshire; Thornley Quarry, Chipping, near Preston (Lancashire).

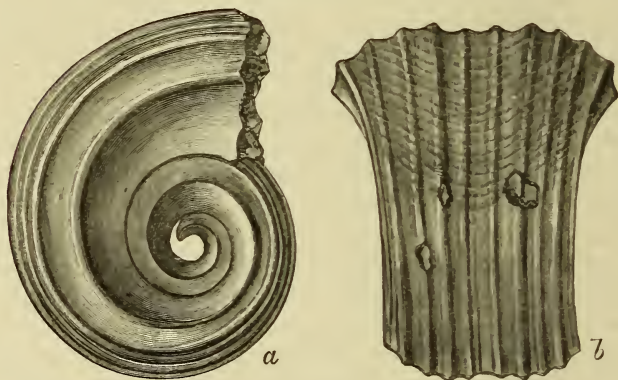
Represented in the Collection by a large number of specimens, including one of Sowerby's types ("Sowerby Collection") figured in the 'Mineral Conchology,' tab. cccclxxxii. f. 3.

¹ *N. sulciferus*, Phillips (*loc. cit.*).

***Cælonutilus multicarinatus*, J. de C. Sowerby, sp.**

1825. *Nautilus multicarinatus* (pars), J. de C. Sowerby, Min. Conch. vol. v. p. 129, tab. cccclxxxii. f. 1 (excl. f. 2).
 1836. *Nautilus multicarinatus*, Phillips, Geology of Yorkshire, pt. ii. p. 232.
 1843. *Nautilus multicarinatus*, Portlock, Geol. of Londonderry, p. 405.
 1844. *Nautilus* (*Temnocheilus*) *porcatus*, M'Coy, Synop. Carboniferous Foss. Ireland, p. 22, pl. iii. f. 6.
 1849. *Nautilus multicarinatus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 110.
 1852. *Nautilus multicarinatus* (pars), Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 174.
 1854. *Nautilus multicarinatus*, Morris, Cat. British Foss. 2nd ed. p. 308.
 1860. *Temnocheilus multicarinatus*, Griffith, Journ. Geol. Soc. Dublin, vol. ix. p. 57.
 1878. *Nautilus multicarinatus*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), p. 139, pl. xxix. ff. 4, a-c.

Fig. 16.



Cælonutilus multicarinatus.—*a*, lateral view, showing the central perforation; *b*, peripheral view, partly restored, the specimen having been cut and polished on one side to show the septa &c. Drawn from a specimen in the Collection. The figure is slightly smaller than the original.

Sp. Char. The following is Sowerby's description of this species:—"Discoid, subglobose; inner whorls half exposed in a large deep umbilicus; edge of the umbilicus angular; front compressed, with several carinæ on each side of the middle." He continues:—"The sides of the whorls of this *Nautilus* are very narrow and concave; the front, which is broad, has in its middle a concave band, on each

side of which are four sharp ridges besides the one that bounds the sides;" and then he adds, "it is probable that these ridges diminish in number as the shell advances, for the larger specimen (fig. 2) has but two in place of four, and these even are lost near the aperture."

Remarks. The specimens belonging to this species in the British-Museum Collection prove conclusively that the number of keels does not depend upon the age of the shell, as supposed by Sowerby, and that the latter included under the name *multicarinatus* two distinct types, one of which will now bear that name, and the other the name *paucicarinatus*, bestowed by the present writer.

De Koninck figures a young individual of this species under the name *multicarinatus*, and in his reference to Sowerby's figures (Min. Conch. pl. cccclxxxii. *loc. cit.*) he very rightly excludes fig. 2, and selects fig. 1 as the type of Sowerby's species. It may be added that the specimen figured by de Koninck agrees with Sowerby's fig. 1 in the number of keels (10) on the periphery, and not with fig. 2.

The septa in this species are very numerous, but irregularly spaced; they are from 2 to $2\frac{1}{2}$ lines distant from each other, where the diameter of the whorl is about 6 lines, while the last three or four septa near the body-chamber are not more than $1\frac{1}{2}$ line apart. A portion of the body-chamber seen in section occupies nearly half a volution, but it is imperfect at the apertural extremity. The surface of the test is covered with fine transverse lines of growth.

Both Giebel and d'Orbigny observed the identity of M'Coy's *porcatus* with Sowerby's *multicarinatus* (pars), but they appear to have supposed that the two figures given by Sowerby represented one and the same species. The paucity of keels in fig. 2, as compared with fig. 1, is not noticed by them, but Giebel remarks that probably *T. porcatus* is only a compressed fragment of *N. multicarinatus*.

A species is recorded by Phillips under the name *multicarinatus*, Sow., from Cork and Cumberland; and as he speaks of it in his (very brief) description as possessing many spiral ridges and furrows, there is very little doubt that he was dealing with the present species.

Horizon. Carboniferous Limestone.

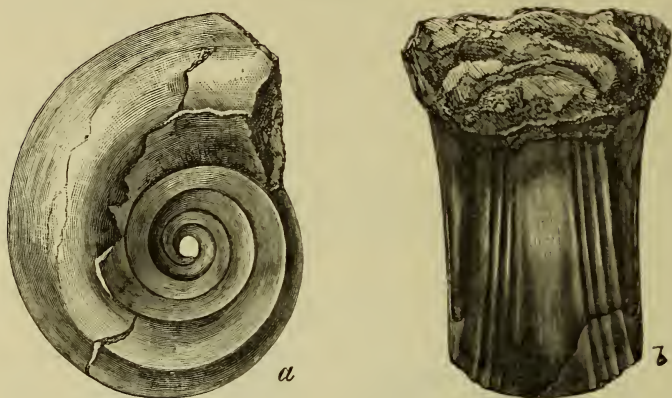
Localities. Cork, Kildare.

Well represented in the Collection, which contains ("Sowerby's Collection") the specimen figured by Sowerby in the 'Mineral Conchology,' besides other examples.

***Coelonautilus paucicarinatus*, Foord.**

1825. *Nautilus multiearinatus* (pars), J. de C. Sowerby, Min. Conch. vol. v. p. 129, tab. cccclxxxiii. f. 2 (excl. f. 1).
 1878. *Nautilus cariniferus*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), p. 134, pl. xxviii. ff. 1-5. (Not of J. de C. Sowerby.)

Fig. 17.



Coelonautilus paucicarinatus.—*a*, lateral view, showing the central perforation; *b*, front view, showing the peripheral keels. Drawn from a specimen in the Collection. One half natural size.

Sp. Char. Shell thick, discoid, composed of three volutions, only just touching each other, all being exposed to view in a very deep, step-like umbilicus, in which there is a small central perforation. The periphery is very broad and is bordered on each side in the young and adolescent shell by sharp keels, but these become obsolete in the adult. There is also a similar keel at the edge of the umbilicus, which shares the fate of the former. The periphery in the young shell bears also two, sometimes three, keels on either side, leaving a wide and slightly hollow area in the centre. These keels are scarcely defined in the adult shell, but their place is taken by a ridge, or narrow convexity, which extends quite to the edge of the aperture. The latter has a similar form to that of *C. cariniferus*, J. de C. Sow. The body-chamber occupies exactly half of the last whorl. The impression of the retractor muscle is seen indistinctly upon the cast of the body-chamber of a large specimen (registered No. 43862); and the marks of the mantle, consisting of a series of closely arranged, punctured lines, are visible in the same example. The septa are approximate, gradually increasing in their distance

from each other, the last two or three near the body-chamber being a little nearer than those immediately preceding them. The siphuncle is situated above the centre, or about $\frac{1}{3}$ of the distance across the ventro-dorsal diameter. The whole surface of the test is covered with fine lines of growth, which are visible to the naked eye. One of the specimens in the "Sowerby Collection" (No. 43861) exhibits very distinct colour-markings, arranged in spots or irregular bands of a blackish hue.

Remarks. This species differs from *C. cariniferus*, J. de C. Sow., in having an extra keel inside the umbilicus (*cf.* fig. 15, *D*). Closely allied to the present species is the *Nautilus pinguis*, de Koninck, next to be described; in this the young shell (for about half a volution) is longitudinally ridged, as in some species of *Discites*, and it has also a row of crenulations on each keel, up to the end of the first whorl.

Horizon. Carboniferous Limestone.

Locality. Ireland; one specimen (registered No. 50189), from Cork.

Represented in the Collection by several examples, including the one figured by J. de C. Sowerby (*loc. cit.*), now in the "Sowerby Collection."

Coelonautilus pinguis, de Koninck, sp.

1844. *Nautilus pinguis*, de Koninck, Descrip. des Anim. Fossiles du Terr. Carbonifère de la Belgique, p. 551, pl. xlviii. f. 10. (*Not of M'Coy.*)

1849. *Nautilus pinguis*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 111.

1852. *Nautilus pinguis*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 173.

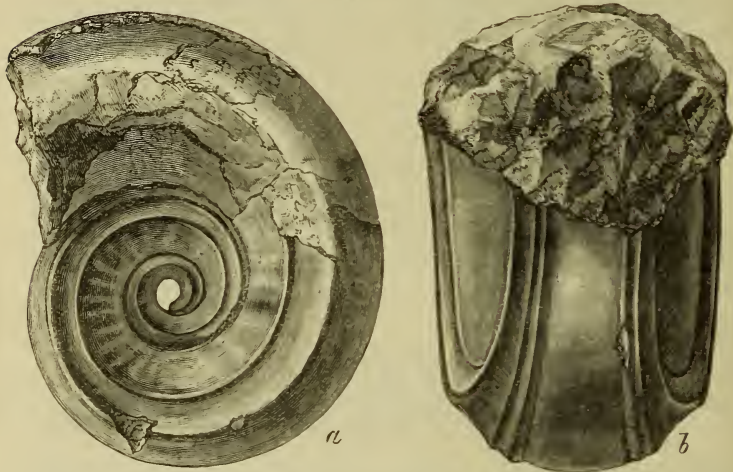
1878. *Nautilus pinguis*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), p. 136, pl. xxx. ff. 6 a-c, 7 a-c.

Sp. Char. Shell thick, discoid, composed of about two and a half slightly embracing volutions, all exposed in a very deep umbilicus, which has rather a large perforation in the centre. The first whorl, for about half its length, has fine longitudinal striæ or ridges, one of which is continuous and forms one of the lateral keels. At the commencement of the second whorl the periphery is slightly depressed and bears on each side a double keel, which gradually becomes obsolete till it finally disappears completely upon the last whorl, near the aperture. The periphery, losing the keels, here becomes rounded, so that it presents in section an ellipse of which the two extremities of the longer axis are truncated. The two keels encircling the whorls are finely crenulated, at least up to

the termination of the first whorl, and often even as far as the extremity of the second, after which the crenulations disappear and the keels become simple.

The septa are moderately distant from each other, numbering about twenty-five in a complete whorl; the sutures are straight throughout their whole extent. The body-chamber is large, and occupies about half of the last whorl. The siphuncle is relatively

Fig. 18.



Caelonutilus pinguis.—*a*, lateral view, showing the central perforation and the colour-bands, indicated by the lighter shaded radiating spaces in the umbilicus; the serrations on the keels of the inner whorls are too fine to be figured: *b*, front view, showing the peripheral keels. The specimen is a little distorted. Drawn from a specimen in the Collection. Natural size.

large, and is situated at the superior third of the ventro-dorsal diameter. The test is very thin and its surface is covered with fine irregular lines of growth, scarcely visible to the naked eye; their direction indicates that the border of the aperture was sigmoidal at the sides and deeply emarginate on the periphery, as in *cariniferus*.

Remarks. De Koninck's name having priority over M'Coy's, the latter was changed to *N. Cohanus* by d'Orbigny¹. The example which I have figured above (No. 43862) shows distinct light-coloured bands on the inner slope of the whorls, the traces of the colour-ornaments of the shell.

The present species differs from *paucicarinatus* (= *N. cariniferus*,

¹ Prodrôme de Paléont. Stratigr. 1849, vol. i. p. 111.

de Kon., non Sow.) by the possession of fine ridges in the young shell, and crenulations in the later stages of growth, and also by the lesser amount of enrolment, whereby the outer keel of the umbilicus is exposed in the inner whorls. The sutures also are more sinuous in *paucicarinatus* than in *pinguis*.

Horizon. Calcaire Carbonifère (Assise 1e), = Carboniferous Limestone.

Locality. Tournai, Belgium.

Well represented in the Collection.

***Cœlonautilus Koninckii*, d'Orbigny, sp.**

1844. *Nautilus cariniferus*, de Koninck, Descrip. des Anim. Foss. du Terr. Carbonifère de la Belgique, p. 549, pl. xlviii. ff. 11, *a*, *b*, and 12. (Not of J. de C. Sowerby.)
- ? 1844. *Nautilus* (*Temnocheilus*) *crenatus*, McCoy, Synop. Carboniferous Foss. Ireland, p. 21, pl. ii. f. 9.
1847. *Nautilus Koninckii*, d'Orbigny, Paléont. Universelle, vol. i. pl. xcv. ff. 1-6.
1849. *Nautilus Koninckii*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 111.
1852. *Nautilus Konincki*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 172 (excl. synon.).
1852. *Vestinautilus Koninckii*, Ryckholt, Notice sur les Genres *Nautilus*, *Vestinautilus*, &c. p. 5, pl. — f. i.
1854. *Nautilus Koninckii*, Pictet, Traité de Paléont. vol. ii. p. 623, plate 50. fig. 5.
1856. *Nautilus cariniferus*, F. Roemer, in Bronn's Lethæa Geognostica, 3te Aufl. Band i. p. 496, Taf. i. 1, ff. 9, *a*, *b*. (Not of J. de C. Sowerby.)
1872. *Nautilus Koninckii*, Hyatt, Bull. Mus. Comp. Zool. Harvard Coll. Cambridge, Mass., vol. iii. No. 5 (Embryology), p. 91, pl. iv. ff. 7, 8, 9 (apex).
1878. *Nautilus Koninckii*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), p. 137, pl. xxx. ff. 1-5.
1883. *Vestinautilus Koninckii*, Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 295.

Sp. Char. Shell thick, discoid, composed of three volutions, just touching each other, excepting at the extreme apex; umbilicus deep on both sides of the shell, and having a very large perforation in the centre. Prof. Hyatt¹ found that "one fine specimen of *Nautilus Koninckii*, from Tournai, had apparently a smooth termination;" the longitudinal plications reaching only a little beyond the second

¹ Bull. Mus. Comp. Zool. Cambridge, 1872, vol. iii. No. 5, p. 75.

septum. "The whorl," he continues, "was here a rapidly increasing cone, the abdomen [periphery], however, quite as gibbous as the dorsum, whereas in the adult the latter is the more prominent, the abdomen becoming deeply inflected. The termination of the whorl was very much flattened, so that from the side it had quite a pointed aspect, whereas an abdominal view showed it to be rounded at the extremity." He adds that "the whorls do not . . . touch at first. The tip of the cone is free for some distance before the involution brings the whorls in contact. No marks of a cicatrix were discernible."

In the initial part of the shell, as observed by M. de Koninck, the ventro-dorsal diameter exceeds the transverse, but as growth proceeds the reverse takes place, and the lateral diameter greatly exceeds the ventro-dorsal, while at the same time the fine longitudinal ridges disappear and leave only three keels on each side of the periphery, the outer one of which forms the edge of the umbilicus. Another keel remains just inside the umbilicus, making altogether four on each side.

All the keels have their edges finely crenulated, and on close examination it is found that these crenulations or serrations are caused by a number of minute, transversely elongated and slightly oblique nodes, of the same character as those described in *Gyroceras serratum*, de Kon., *G. tessellatum*, de Kon., &c. The serrations entirely disappear when the last whorl is attained. Very fine lines of growth cover the whole surface of the shell.

The septa number twenty-four in a volution; they are shallow, and their sutures are strongly sigmoidal on the sides of the shell, bent backwards at the lateral angles, and forming a deep sinus upon the periphery. The body-chamber is large, occupying a little more than half of the last volution. The siphuncle is small and is situated a little above the centre.

Remarks. The first whorl of this species would be difficult to distinguish from *C. pinguis*, but the periphery remains convex in that species, whilst in *C. Koninckii* it becomes flattened and even slightly concave. The rate of increase is also more rapid in *C. pinguis* than in *C. Koninckii*, and the septal sutures much more sigmoidal laterally and more strongly bent backwards in the latter than they are in the former.

M. de Koninck expresses the opinion that *Nautilus (Temnocheilus) crenatus*, McCoy, cannot be regarded as identical with *C. Koninckii*, as supposed by Giebel¹, because the keels in the latter are never

¹ Fauna der Vorwelt, 1852, Band iii. Abth. i. p. 173.

crenulated upon the last whorl. He suggests that *crenatus* may be only a variety of *C. cariniferus*. The fragment figured by M'Coy is, however, too imperfect to be determined without more material.

Horizon. Calcschistes de Tournai (Assise 1 *e*), = Carboniferous Limestone.

Locality. Tournai, Belgium.

Fairly well represented in the Collection.

***Cœlonautilus subsulcatus*, Phillips, sp.**

1836. *Nautilus subsulcatus*, Phillips, Geol. of Yorkshire, pt. ii. p. 233, pl. xvii. ff. 18, 25. (Not of J. de C. Sowerby, nor H. Trautschold, nor F. Roemer.)
1836. *Nautilus sulcatulus*, Phillips, *ibid.* "Reference to the Plates of Organic Remains," p. 250.
1844. *Nautilus subsulcatus*, de Koninck, Descrip. des Anim. Foss. du Terr. Carb. de la Belgique, p. 548, pl. xlvii. ff. 9, *a*, *b*, pl. xlix. ff. 4, *a*, *b* (not pl. xxx.).
1844. *Nautilus (Discites) subsulcatus*, M'Coy, Synop. Carboniferous Foss. Ireland, p. 19.
1847. *Nautilus subsulcatus*, d'Orbigny, Paléont. Universelle, vol. i. pl. xcii. ff. 1-6.
1849. *Nautilus subsulcatus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 110.
1852. *Nautilus subsulcatus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 176.
1854. *Nautilus subsulcatus*, Morris, Cat. Brit. Foss. p. 309.
1855. *Nautilus (Discites) quadratus*, M'Coy, British Pal. Foss. fasc. iii. p. 560.
1860. *Discites subsulcatus*, Griffith, Journ. Geol. Soc. Dublin, vol. ix. p. 56.
- ? 1860. *Nautilus subsulcatus*, Eichwald, Lethæa Rossica, vol. i. Seconde Sect. de l'ancienne Période, p. 1312, pl. xlix. f. 21 (a fragment only).
1873. *Nautilus (Discites) subsulcatus*, de Koninck, Rech. sur les Anim. Foss. vol. ii. p. 110, pl. iv. f. 10.
1877. *Nautilus subsulcatus*, de Koninck, Rech. sur les Anim. Foss. Paléoz. de la Nouv.-Galles du Sud, p. 345, pl. xxiv. f. 4.
1878. *Nautilus subsulcatus*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), pt. i. p. 132, pl. xxvii. ff. 13, 14.
1883. *Nautilus subsulcatus*, Gaudry, Les Enchaînements du Monde Animal dans les Temps Géologiques (Foss. primaires), p. 174, fig. 171.
1883. *Trematoceras subsulcatum*, Hyatt, "Genera of Fossil Cephalopods," Proc. Boston Soc. Nat. Hist. vol. xxii. p. 292.

Sp. Char. "Discoidal, smooth, with many sharp sigmoidal [transverse] and some spiral striæ; whorls quadrangular, the back concave along the middle, bevelled to the side; the sides concave toward the outer edge and convex toward the abrupt marginal slope; siphuncle near the outer edge, aperture oblong (analogous to *N. subsulcatus*)."
(*Phillips*.)

Remarks. Unfortunately Phillips's type specimen is a cast, so that its characters were not fully recognized until the species was figured by de Koninck from more complete specimens. These show that there were two sharp keels upon the periphery, separated by a shallow channel, which is scarcely perceptible on the type specimen.

There are not more than three whorls in the present species, not five, as described by McCoy; they are all exposed and leave a small central perforation. The septa are moderately distant, the sutures forming a shallow sinus upon the sides of the shell and bending sharply backwards upon the periphery. Fragments of the test¹ show that it was covered with very fine lines of growth, curved sigmoidally on the sides of the shell, as figured by de Koninck².

It is very doubtful whether the fragment figured by Eichwald (*Leth. Ross.* vol. i. pt. ii. p. 1312, pl. xlix. f. 21) under the name *Nautilus subsulcatus* belongs to the present species. It was found in the Lower Carboniferous Limestone near Borowitschi, in the Government of Novgorod.

A species described by de Verneuil³ under the name *Nautilus bicarinatus* may be the young of the present species, judging by the description and figure, though de Koninck differentiates it on the ground that it is much more rounded in section.

Horizon. Calcaire de Visé (Assise vi.), = Carboniferous Limestone.

Localities. *British.* Bolland, Yorkshire; Derbyshire; Isle of Man.—*Foreign.* Visé, Belgium.

Well represented in the Collection, which contains Phillips's type specimen (registered No. C. 237, "Gilbertson Collection").

***Cœlonautilus quadratus*, Fleming, sp.**

1828. *Nautilus quadratus*, Fleming, *Hist. of British Animals*, p. 231.

1840. *Nautilus subsulcatus*, var., J. de C. Sowerby, in Prestwich's "Geology of Coalbrookdale," *Trans. Geol. Soc.* vol. v. pt. iii. p. 492, and *Explanation of Plates*, xl. f. 7.

1843. *Nautilus subsulcatus*, var., Portlock, *Geol. of Londonderry*, p. 405.

¹ See specimen registered No. C. 238.

² *Descrip. des Anim. Foss. du Terr. Carbon. de Belgique*, 1844, pl. xlix. f. 4.

³ *Géol. de la Russie d'Europe*, by Murchison, de Verneuil, and de Keyserling, vol. ii. pt. iii. p. 364, pl. xxv. ff. 10, a, b.

1855. *Nautilus (Discites) quadratus* (pars), M'Coy, British Palæozoic Fossils, fasc. iii. p. 560.
1863. *Nautilus subsulcatus*, F. Roemer, Zeitschr. der Deutsch. geol. Gesell. Band xv. p. 575, Taf. xiv. ff. 6a, 6b. (Not of Phillips.)
1870. *Nautilus subsulcatus*, F. Roemer, Geologie von Oberschlesien, p. 82. (Not of Phillips.)
1874. *Nautilus quadratus*, Young and Armstrong, Trans. Geol. Soc. Glasgow, vol. iv. pt. iii. p. 281.
1876. *Nautilus (Discites) quadratus*, Armstrong, Young, and Robertson, Cat. of Western Scottish Fossils, p. 59.

Sp. Char. "Discoid, compressed, of little more than two volutions; section of the whorls subquadrate; the sides and periphery nearly equal in width, flattened, and at right angles; the sloped sides of the umbilicus very steep, and about as wide as the inner margin between them; periphery usually flat in the middle, and very slightly sloping at the sides towards the lateral angles, each lateral fourth bearing from one to five fine thread-like ridges (most usually the former number); sides sometimes nearly flat, or the half near the umbilicus moderately convex, and the outer half moderately concave; but many specimens having each side obtusely ridged along the middle by two broad shallow sulci, while a few rare specimens have the sides divided into five coarse subequal ridges by three wider concave sulci; occasionally also the middle part of the periphery is more prominent than the lateral thirds, and concave (sometimes all these varieties in a single specimen). Surface crossed by very minute sigmoid striæ on the sides, arched backwards on the inner half, also strongly arched backwards on the middle of the periphery (where, in perfect preservation, the transverse striæ are crossed by minute spiral ones under the lens). Septa moderately numerous, their edges gently arched backwards on the sides and periphery; body-chamber occupying half of the last whorl; siphon small, close to the outer edge . . ." (*M'Coy*.)

Remarks. Two fragments of the body-chamber of this species in the Collection, from Scotland, exhibit the following characters:—The section is a little wider than high and subquadrate in form, the periphery is slightly rounded, its edges are bordered by sharp keels, and it has also two acute ridges or keels which mark off longitudinally a central space representing nearly one half of its area. Between these median keels and the edge of the periphery there is a very fine thread-like line. The sides of the shell are inflated below and somewhat concave above, a narrow ridge occupying the concavity. The edge of the umbilicus is separated by a shallow groove from the inflated part of the whorl. The sides of the umbilicus slope steeply down to the point of contact with the preceding whorl,

the latter leaving a shallow furrow upon the dorsal side. The whole surface of the test is covered with fine lines of growth, which are a little stronger upon the edges of the periphery, and form a deep sinus upon the latter.

Some of the specimens vary a little in details of sculpture, the smaller ridge in the concave space upon the sides being sometimes absent. In fact, according to M'Coy's description of it, this is a very variable species.

It will be seen that J. de C. Sowerby recognized that *C. quadratus* differed from *C. subsulcatus*, Phil., sp., as he made it a variety on account of its "shorter aperture" (Trans. Geol. Soc. *loc. cit.*). His excellent figure shows that he had a better specimen than most of those which have been collected.

The present species, though resembling *C. subsulcatus* in some points, differs from it in having a proportionately wider periphery, and in the details of its ornaments.

Horizon. Coal-Measures (English specimens); Lower Limestone Group¹ (Scotch specimens).

Localities. Coalbrookdale, Bewdley, Shropshire; Craigenglen, two miles south of Lennoxton, Stirlingshire; Lanark.

Well represented in the Collection.

***Cœlonutilus sulcifer*², Leveillé, sp.**

1835. *Nautilus sulcifer*, Leveillé, Mém. Soc. Géol. de France, vol. ii. p. 38, pl. ii. ff. 1, 2.

1835. *Nautilus dorsatus*, Leveillé, *ibid.* pl. ii. ff. 3, 4.

1844. *Nautilus sulcatus*, de Koninck, Descrip. des Anim. Foss. de la Belgique, p. 545, pl. xlviii. ff. 8, 9 (excl. pl. xlvii. ff. 10, *a, b*, et *synon.*).

1847. *Nautilus sulcifer*, d'Orbigny, Paléont. Universelle, pl. xciii. ff. 6-9.

1849. *Nautilus sulcifer*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 110.

1854. *Nautilus sulcifer*, Morris, Cat. British Fossils, 2nd ed. p. 308.

1860. *Nautilus (Discus) trisulcatus*, Meek and Worthen, Proc. Acad. Nat. Sci. Phil. p. 470.

1861. *Nautilus (Trematodiscus) trisulcatus*, Meek and Worthen, *ibid.* p. 148.

1866. *Nautilus (Trematodiscus) trisulcatus*, Meek and Worthen, Geol. Surv. Illinois, vol. ii. Paleont. p. 162, pl. xiv. ff. 10, *a-c*.

¹ The rocks of the Carboniferous Limestone Series of Scotland are enumerated in Part I. of the present Catalogue, in the footnote on p. 121.

² This must not be confounded with the *Nautilus sulciferus* of Phillips (Geol. of Yorkshire, 1836, pt. ii. p. 232), which is probably identical with *Cœlonutilus cariniferus*, J. de C. Sowerby, sp.

1878. *Nautilus sulcifer*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), p. 130, pl. xxvii. ff. 12 a, 12 b.

Sp. Char. Shell thick, discoid, composed of three slightly embracing whorls, all exposed in a deep umbilicus, which has a small central perforation. The transverse section is subcordiform and one third wider than high. The sides are very narrow and inflated, with a keel bordering the edge of the umbilicus in the young shell, which becomes obsolete in the adult. The periphery is occupied by a very prominent raised band, channelled in the centre, on each side of which there is an abrupt slope towards the edge of the umbilicus, and upon these slopes the young shell bears three keels or ridges, which gradually disappear as the shell advances in growth. The body-chamber occupies about half of the last whorl.

The septa are moderately distant from each other; about twenty-three may be counted in a single volution of a young example whose greatest diameter is 15 lines. The sutures are slightly sinuous upon the sides, and form a slight, backwardly directed sinus upon the periphery.

The siphuncle is slender, and is situated a little above the centre.

The test is unknown, all the specimens collected being casts. The surface of the cast is, however, beautifully marked with a series of fine, transverse, sinuous incised lines, which in some parts of the body-chamber become broken up into dotted lines. These markings are seen upon the cast of the septate part of the shell as well as on that of the body-chamber, and they are evidently similar to those described in *Cœlonutilus cariniferus* and *C. paucicarinatus*, and must have had the same origin¹.

Remarks. The following observations concerning the American examples of this species are taken from Messrs. Meek and Hayden's description (*loc. cit.* p. 163). "This species bears some resemblance to certain varieties of *N. sulcatus* of Sowerby, as figured by de Koninck (Anim. Foss. pl. xlvii. fig. 10, and pl. xlviii. figs. 8, 9), but differs in the number and arrangement of its revolving angles, and in the possession of longitudinal striæ. It is still more nearly allied to *N. Edwardsianus*, de Koninck (Suppl. Anim. Foss. pl. lix. figs. 7, a, b, c), but differs in having less compressed whorls which are rounded instead of angular around the umbilicus, while its dorsal

¹ Similar markings have been noticed and figured by Barrande, who ascribes them to the same cause (see Syst. Sil. de la Bohême, 1868, vol. ii. pl. cclxxxiii. (*Orthoceras subannulare*, Münster.), pl. cccii. (*O. severum*, Barr.), and numerous species besides). They may also be compared with the impressions of the surface of the mantle so admirably preserved in many specimens of *Geotecthis* from the Lias and Oxford Clay, and of *Plesioteuthis* from the Solenhofen Slates.

carinae are less prominent. Our specimen being merely a cast, we have no means of determining how near these two forms may have agreed in the details of their surface-markings."

The American examples of this species were obtained at Rockford, Indiana, in the Goniatites beds of the Kinderhook Group (Lower Carboniferous), and are associated, as at Tournai, with *Goniatites rotatorius*, de Kon. (= *G. Ixion*, Hall).

The prominent raised band upon the periphery clearly separates this species from any which it resembles in other respects.

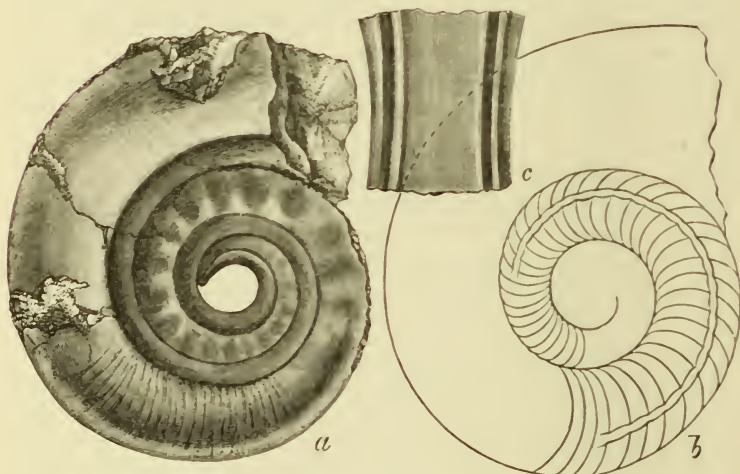
Horizon. Calcaire noir de Tournai (Assize i. e). = Carboniferous Limestone.

Locality. Tournai, Belgium.

Represented in the Collection by two examples.

***Cælonautilus gradus*¹, Foord.**

Fig. 19.



Cælonautilus gradus.—*a*, lateral view of a nearly perfect specimen, showing the large central perforation; *b*, outline of a polished section of another individual showing the septa and siphuncle, and nearly the whole of the body-chamber; *c*, part of the periphery of another specimen, showing the longitudinal ridges. Drawn from specimens in the Collection. All of the natural size.

Sp. Char. Shell thick, discoid, composed of about two and a half or three whorls, only just touching, and all exposed in a deep, step-

¹ Expressive of the step-like form of the umbilicus.

shaped umbilicus, perforated in the centre. The whorls are distinctly subquadrate in section. The periphery is broad and slightly concave, with two keels on each side, one upon the outer edge and the other just inside it. The sides, which are not quite as wide as the periphery, slope a little outwards towards the umbilical margin; their surface is slightly convex, and there are traces on the inner whorls of broad, transverse folds, which become obsolete when the outer whorl is reached. The surface of the test is ornamented with fine lines of growth, which form a deep sinus upon the periphery, corresponding with the emargination of the aperture. Fine longitudinal lines are also present on and between the keels on each side of the periphery, but they do not appear to be developed elsewhere. The cast beneath the shell is marked by a series of minute, interrupted, incised lines and punctures, indicating that the surface of the mantle was granular and wrinkled, as in *Cælonautilus cariniferus*, &c. (fig. 15).

The body-chamber occupies at least half of the last whorl, its aperture is not preserved in any of the specimens examined.

The septa are very approximate, and number thirty-eight to a whorl in a specimen whose greatest diameter is $2\frac{1}{2}$ inches. The siphuncle is situated a little above the centre.

Remarks. The distinguishing characters of this species are its slow rate of tapering and the quadrate form of the whorls. The species which comes nearest to it is *Cælonautilus subsulcatus*, Phillips, sp.; but *C. gradus* has a much less rapid rate of increase, closer septa, and proportionately broader periphery than Phillips's species.

Horizon. Carboniferous Limestone.

Locality. Kildare.

Well represented in the Collection.

***Cælonautilus globatus*, J. de C. Sowerby, sp.**

1821. *Nautilus globatus*, J. de C. Sowerby, Min. Conch. vol. v. p. 129, pl. cccclxxxi.

? 1823. *Nautilus Wrightii*, Fleming, History of British Animals, p. 230.

1834. *Nautilus globatus*, Klöden, Verstein. der Mark Brandenburg, p. 126.

1834. *Nautilus globatus*, Kefenstein, Naturgesch. des Erdk. Band ii. p. 506.

1842. *Nautilus globatus*, d'Archiac and de Verneuil, Trans. Geol. Soc. ser. ii. vol. vi. pt. ii. p. 386.

? 1843. *Nautilus globatus*, de Koninck, Descrip. des Anim. Foss. du Terr. Carbonifère de Belgique, p. 554, pl. xlvii. ff. 11 a, 11 b.

1844. *Nautilus (Temnocheilus) globatus*, M'Coy, Synop. Carboniferous Foss. Ireland, p. 21.
1849. *Nautilus globatus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 111.
1852. *Nautilus ingens*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 166. (Not of Martin.)
1854. *Nautilus globatus*, Morris, Cat. of British Fossils, 2nd ed. p. 308.
1860. *Temnocheilus globatus*, Griffith, Journ. Geol. Soc. Dublin, vol. ix. p. 77.
- ‡ 1860. *Nautilus subglobosus*, Meek and Worthen, Proc. Acad. Nat. Sci. Philad. p. 469.
- ‡ 1866. *Nautilus globatus*, Meek and Worthen, Geol. Surv. Illinois, vol. ii. p. 305, pl. xxiv. ff. 5 a, 5 b.
1876. *Nautilus globatus*, Armstrong, Young, and Robertson, Cat. of Western Scottish Fossils, p. 59.
1878. *Nautilus Atlantoideus*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), p. 97, pl. xi. ff. 1 a, 1 b, 2 a, 2 b.
1883. *Vestinautilus globatus*, Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 295.
- [Not 1836. *Nautilus globatus*, Phillips, Geol. of Yorkshire, pt. ii. p. 232, pl. xvii. ff. 20, 28 ?.—1855. *Nautilus globatus*, M'Coy, British Pal. Foss. fasc. iii. p. 558.—1878. *Nautilus globatus*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), p. 95, pl. x. ff. 2-4, pl. xxxi. f. 1.—1888. *Nautilus globatus*, Tzwetaev, Mémoires du Comité Géologique [Russia], vol. v. no. 3, p. 54, pl. v. ff. 25, 26.]

Sp. Char. "Subglobose, smooth, umbilicated; whorls few, inner ones concealed, rather flattened on the front, rapidly increasing; umbilicus deep, with an angular margin; aperture very wide, arched, with a deep sinus in the front." (*Sowerby.*)

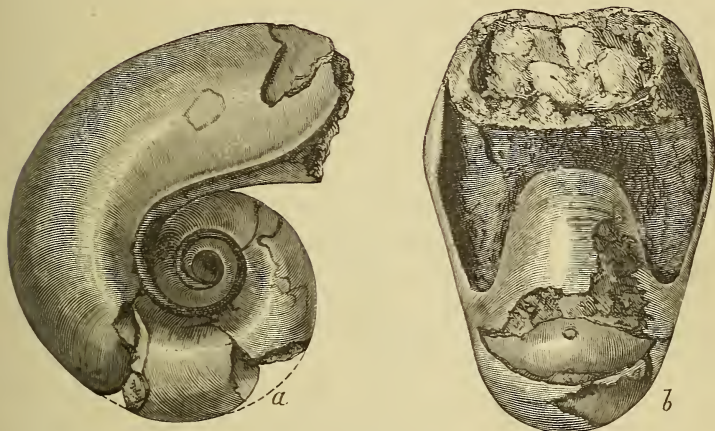
Remarks. The characters of this shell are very well marked. The whorls are two and a half or three in number, and all exposed in a deep umbilicus, the sides of which are very steep, and are bordered by a sort of keel which is slightly inflected, so as to overhang, as it were, the umbilicus. The shell increases rapidly in size, and is very globose in the young, but becomes flattened upon the periphery in the adult, the ratio of the transverse to the ventro-dorsal diameter being as 30:21. At a little distance from the aperture the body-chamber becomes straightened and a little produced beyond the coiled part, both in young and adult shells. The body-chamber occupies about half the last whorl. The septa are rather approximate, their distance in a young shell being about $\frac{1}{5}$

the ventro-dorsal diameter. The siphuncle is unknown. The surface of the test appears to be perfectly smooth.

Neither of the forms figured by Phillips belong to the present species, and they are also evidently distinct from each other.

The fragment of the body-chamber (Geol. of Yorkshire, pt. ii. pl. xvii. f. 28) now in the "Gilbertson Collection" in the British Museum is too imperfect for identification.

Fig. 20.



Calonautilus globatus.—*a*, lateral view, showing the deeply excavated umbilicus; *b*, front view, showing the pinched form of the aperture and the keeled edge of the umbilicus; the siphuncle is seen where a portion of the shell has been broken away. Drawn from a specimen in the Collection. About one half the natural size.

Sowerby's figures do not show the angular, almost keeled character of the umbilical margin, all his specimens having the umbilicus filled with matrix. It is probably owing to this that M'Coy¹ and other authors have mistaken other species for *globatus*. Both M'Coy and de Koninck regard the *bistrialis* of Phillips as identical with the present species, but I think it can be clearly shown that the two are distinct.

Messrs. Meek and Worthen (Geol. of Illinois, vol. ii. *loc. cit.*) describe their form as differing from Sowerby's species only in the size of the siphuncle, which is smaller in the American form than in the English, judging by M'Coy's description of it in the 'British Palæozoic Fossils' (p. 559). But as M'Coy in that work was not

¹ In 'British Palæozoic Fossils,' 1855, Sedgwick and M'Coy, p. 558, but not in the 'Synopsis of the Carboniferous Fossils of Ireland,' 1844, p. 21.

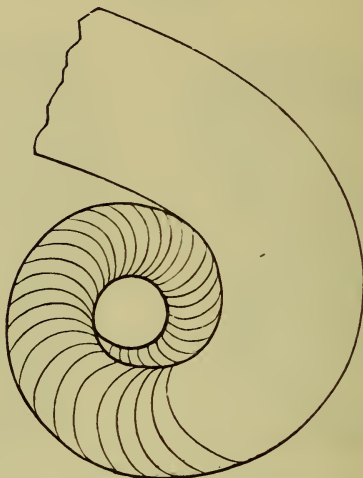
describing Sowerby's species but some other, the character relied upon by Meek and Worthen becomes of no importance.

Judging by the figures and description, I should say that the *globatus* of the American authors is not that of Sowerby.

Horizon. Carboniferous Limestone.

Localities. Cork, Kildare.

Fig. 21.



Celonautilus globatus.—Outline of a polished section, showing the septa and the greater part of the body-chamber. Drawn from a specimen in the Collection. Natural size.

Well represented in the Collection, which contains ("Sowerby Collection") the type specimens figured by Sowerby in the 'Mineral Conchology,' besides other examples.

***Celonautilus bistrialis*, Phillips, sp.**

1836. *Nautilus bistrialis*, Phillips, Geol. of Yorkshire, pt. ii. p. 232, pl. xvii. f. 21.

1855. *Nautilus globatus* (pars), McCoy, British Pal. Foss. fasc. iii. p. 558.

1878. *Nautilus globatus* (pars), de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. tom. ii.), p. 95, pl. x. ff. 2a, 2b, 4a, 4b (excl. ff. 3a, 3b, and pl. xxxi. ff. 1a-e).

Sp. Char. This species is briefly described by Phillips as follows:—"Two or three spiral striæ on the edge of the large umbilicus."

The species is very globose, with a broadly rounded periphery, and a very deep umbilicus with steep sides, in which the whorls (about two and a half) are exposed. The edge of the umbilicus is keeled, and the whorls overlap to the margin of the keel, causing the dorsal side of the shell to be deeply emarginate. There were, besides several fine spiral ridges on both sides of the keel, three or four on the inner, and one or two on the outer side; these become obsolete in the adult shell, but they may always be seen upon the inner whorls.

The section in this species is very broad in proportion to the height, the ratio of the ventro-dorsal to the transverse diameter being as 8 : 18, as measured in the most expanded part of a specimen consisting only of the septate part of the shell.

The septa appear to be rather distant from each other, judging by de Koninck's figure (*loc. cit.* pl. x. f. 2 *b*); they are not seen in the British Museum specimens. The siphuncle is situated between the centre and the peripheral margin. The test appears to be quite smooth, nothing but faint lines of growth being seen (type specimen).

Remarks. This species may be readily distinguished by its very broad and globose whorls, deep umbilicus, and the keels surrounding the latter in the young shell.

Horizon. Carboniferous Limestone.

Locality. Bolland, Yorkshire.

Well represented in the Collection, which contains ("Gilbertson Collection") the type specimen described by Phillips in the 'Geology of Yorkshire' (*loc. cit.*).

Cœlonautilus Derbiensis, Foord.

1878. *Nautilus Chesterensis*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), p. 97, pl. xxxi. ff. 4, *a-c* (*excl.* pl. xxiii. ff. 3, *a-c*).

1888. *Nautilus Chesterensis*, Tzvetayev, Mémoires du Comité Géologique [St. Petersburg], vol. v. no. 3, p. 54, pl. v. ff. 19-22.

[Not 1866. *Nautilus Chesterensis*, Meek and Worthen, Geol. Surv. of Illinois, vol. ii. Palæont. p. 306, pl. xxiv. ff. 4 *a*, 4 *b*.]

Sp. Char. Shell subglobose, composed of three whorls, of which the later ones cover the preceding ones to the extent of about one half, all, however, being exposed in a deep umbilicus. The periphery is broad and rounded at the sides; the walls of the umbilicus are very steep. The body-chamber constitutes about one half of the last whorl, its outline is sigmoidal at the sides, and it is deeply

emarginate upon the periphery. The septa number about seventeen or eighteen in a complete whorl, so that they are not very approximate. The siphuncle is central.

The test is covered with fine lines of growth.

Remarks. This species, as observed by M. de Koninck, bears some resemblance to *Cœlonautilus globatus*; but it differs in being much broader, flatter, and less globose, and also in having the umbilical margins rounded, instead of being angular, as in Sowerby's species.

It differs from the *Nautilus Chesterensis*, with which it was associated by de Koninck, in its much larger umbilicus and more distant septa, as well as in its less globose form.

It should be noted that de Koninck's figures of this species, as represented upon plate xxiii. of his work, do not quite agree with those of plate xxxi., the former indicating a shell with a smaller umbilicus and more tumid whorls than the latter.

C. Derbiensis has been found at Visé in Belgium in the "Calcaire Carbonifère Supérieur (Assise vi.)," where it appears to be rare, since only two examples were collected.

Horizon. Carboniferous Limestone.

Locality. Derby.

Represented in the Collection by a single example.

***Cœlonautilus Derbiensis*, var. *globularis*, Foord.**

1878. *Nautilus Chesterensis*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), p. 97, pl. xxiii. ff. 3, a-c (excl. pl. xxxi. ff. 4, a-c).

Sp. Char. This variety differs from the species in being less involute and in having closer septa. If the figures of "*Nautilus Chesterensis*" furnished by de Koninck on plate xxiii. of his work (*loc. cit.*) be compared with those on plate xxxi. the difference in the amount of involution will be seen. This difference is borne out in the specimens which I examined last year in the Royal Museum of Natural History in Brussels, through the courtesy of M. Louis Dollo, and is I think sufficient to justify the separation of these two forms.

There are two specimens in the Collection representing the variety *globularis*, one of which is from the Isle of Man, but the locality of the other has not been recorded.

The specimen from the Isle of Man consists of the septate part of the shell together with a small portion of the body-chamber.

The shell is very globose, and consists of two or two and a half whorls with a very deep umbilicus, the sides of which are sub-

angular. The inner whorls are covered to the extent of at least two thirds by those which succeed them. The section is transversely reniform; the siphuncle is situated a little above the centre. The surface of the test is quite smooth, nothing but faint lines of growth being observable upon it.

Horizon. Calcaire Carbonifère supérieur de Visé (Assise vi.)= Carboniferous Limestone.

Localities. British. Isle of Man.—*Foreign.* Visé, Belgium.

Represented in the Collection by three examples.

***Cœlonautilus infundibulum*, de Koninck, sp.**

1878. *Nautilus infundibulum*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), p. 104, pl. xxiv. ff. 1 a, 1 b.

Sp. Char. Shell thick, discoid, composed of three or four whorls, all exposed in a moderately deep umbilicus. Each whorl covers about half of the preceding one. The whorls in the young shell are keeled in the middle of the sides, the amount of involution of the whorls being exactly limited by the keel, so that the latter is not seen in an adult shell, being hidden by the succeeding whorls. The keel, however, disappears entirely as the shell increases in growth, that is after the first whorl, and the sides of the umbilicus become rounded, though still abruptly sloping. The centre of the periphery in the young shell is occupied by a prominent flattened elevation, with angular borders, and there is an appearance in a very young specimen of there having been two or more keels on each side of the elevation, but the surface of the specimen does not show this distinctly. On each side of the elevation there is a gradual slope down to the keel, already described as forming the border of the umbilicus. The periphery and also the sides become flattened after the completion of about one and a half whorls, and the section of the shell now assumes a subquadrate form, but with rounded angles.

The septa are not very numerous; there are nineteen or twenty in a complete whorl in the specimen figured. The siphuncle is situated a little above the centre. The test is almost smooth, only lines of growth being visible upon it with the aid of a lens.

Remarks. A single imperfect example only of this species is stated by de Koninck to have been found in the 'Calcaire Carbonifère supérieur' of Visé (Assise vi.), but having seen a fine specimen in Mr. James Thomson's Collection, from the black limestone of Castlecary, near Glasgow, he used it to supply what was wanting in the Belgian specimen.

The *Nautilus humilis* of de Koninck¹ bears some resemblance to the present species, in its elevated periphery, the keeled margin of the umbilicus, and somewhat distant septa, but the whorls do not overlap so much as in *C. infundibulum*. *N. humilis* appears to be an immature shell.

Horizon. Carboniferous Limestone.

Locality. Bolland, Yorkshire.

Represented in the Collection by two examples; the one from Bolland (registered No. C. 228) is contained in the "Gilbertson Collection."

Genus **PLEURONAUTILUS**², Mojsisovics³.

(Group of *Nautilus Trautscholdi*, Waagen⁴.)

Gen. Char. Shell thick, discoid, with a wide and moderately deep umbilicus, exposing all the volutions, and having a rather large central perforation. The whorls are subquadrate in section and very slightly embracing. The ornaments consist of strong, straight, or slightly bent transverse costæ, nodose at the edge of the periphery and of the umbilicus, and sometimes also upon the sides. The periphery is smooth in some species (*Pleuronautilus trinodosus*, Mojs.⁵, *P. ampezzanus*, Loretz⁶, &c.), but in others the ribs overlap its edges and meet two ridges which form the boundary of a more or less shallow median furrow (*Pleuronautilus Marmolatae*, Mojs.⁷, *Nautilus transitorius*, Waagen⁸, &c.). The septa are simple, the sutures forming a shallow sinus upon the sides and periphery, and arching forward upon the lateral angles. The ventral sutures in full-grown individuals are nearly straight according to Mojsisovics. A small internal lobe is present. The siphuncle is a little below the centre.

Devonian to Trias.

¹ Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), p. 103, pl. xxiii. ff. 5 a, 5 b.

² I have slightly emended the diagnosis of this genus so as to include in it the Carboniferous forms.

³ Die Cephalopoden der Mediterranen Triasprovinz (Abhandl. der k.-k. geol. Reichsanst. Band x.), 1882, p. 273.

⁴ Mem. Geol. Surv. India—Palæont. Indica, ser. xiii. Salt-Range Fossils, 1879, vol. i. p. 46

⁵ Die Cephalopoden der Mediterranen Triasprovinz, 1882, p. 274.

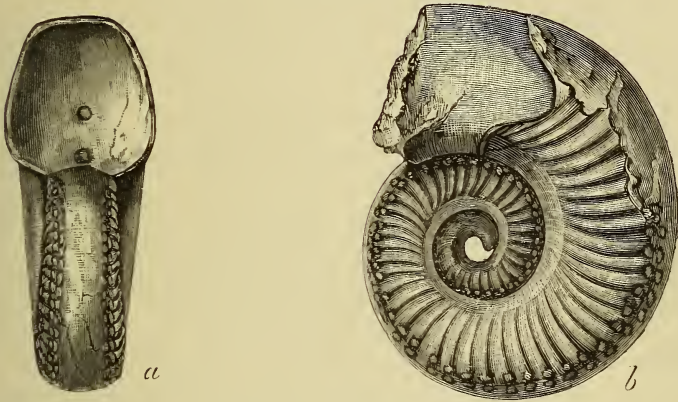
⁶ Ibid. p. 277.

⁷ Ibid. p. 276.

⁸ Mem. Geol. Surv. India—Palæont. Indica, ser. xiii. Salt-Range Fossils, 1879, vol. i. p. 53.

Remarks. "I was at first disposed," says Mojsisovics, "to make *Pleuromutilus* a distinct division of *Temnocheilus*; but the near relationship between *Pleuromutilus* and *Trematodiscus* [*Cælonautilus*] on the one hand, and the distinctness of these two genera from the coexisting *Temnocheilus*-stock [*Stammes*] on the other hand, determined me to introduce *Pleuromutilus* as a distinct genus.

Fig: 22.



Pleuromutilus Mosis.—*a*, front view, showing the siphuncle and the internal or dorsal lobe below it; *b*, lateral view, showing the ornaments of the test and the perforated umbilicus. Reduced one-half from Mojsisovics's figures in Abanhd. d. k.-k. geol. Reichsanst. Band x. 1882, pl. lxxv. ff. 3a, 3b. This species is not in the collection, but the figures are given to illustrate the genus.

"The near relationship between *Trematodiscus* and *Pleuromutilus* can easily be made out. First, the variation in certain species of Carboniferous *Trematodiscus* must be pointed out; this consists in the development in advanced age of a full, rounded shell, free from sculpture [*Nautilus globatus*, Sow., e. g.]. The union of the typical *Trematodiscus* sculpture with the lateral ribs of *Pleuromutilus* is observable in *Gyroceras tessellatum*, de Koninck, *G. binodosum*, Sandberger, *G. costatum*, Goldfuss, *Cyrtoceras rugosum*, Fleming, as well as in *Nautilus nodoso-carinatus*, F. Roemer¹, of the Coal-Measures. Secondly, the characters presented by *Pleuromutilus marmolata* (in which the *Trematodiscus* sculpture passes directly into the *Pleuromutilus* sculpture), added to the appearance in other *Pleuromutili* of several nodose-ridged species (*Pleuromutilus trinodosus*, *P. Mosis*, *P. Cornalica*, *P. Fischeri*, &c.), which are apparently

¹ Geologie von Oberschlesien, Taf. viii, f. 19.

equivalent to the nodose-keeled species of *Trematodiscus*, speak in such a convincing manner in favour of the genetic connection between the two genera [*Trematodiscus* and *Pleuromutilus*] that we do not hesitate to place forms with smooth surface and crenulated ridges, such as *P. gemmatus*, in the genus *Pleuromutilus*.

"As is indicated in *Gyroceras aigoceras*, de Koninck (which possesses the sculpture of *Pleuromutilus*), it seems quite possible that some *Pleuromutiles* have been developed direct from forms with open whorls without passing through a *Trematodiscus* stage . . ."

"The oldest *Pleuromutiles* known to me are found in the Productus-Limestone of the Salt-Range¹, and in the Permian-Kalkstein of the Araxes Pass in Armenia².

"In the Mediterranean Trias *Pleuromutilus* extends upwards to the Middle-Karnischen group; the genus is, however, wanting in the Juvavischen Province."

As I consider that the "Group of *Nautilus Trautscholdi*" of Dr. Waagen, already referred to, may be very properly included in the present genus, I shall take this opportunity of recapitulating the species he comprises in that group, with his remarks thereon, in his own words. The first species mentioned by Waagen is *Nautilus Trautscholdi*, Waagen (= *N. tuberculatus*, Trautschold³, non Sowerby). "This species was found in the Upper Carboniferous limestone of Mjatschkowa. To it some forms in the Salt-Range are most closely related. They form part of the fauna of the Upper Productus-limestone, and I shall describe them under the names of *Nautilus transitorius*, Waagen, and *N. Wynnei*, Waagen⁴. The latter very naturally leads us to *Nautilus dorso-armatus*, Abich, and *N. tubercularis*, Abich⁵, from Djoulfa on the Araxes, and these again furnish the connecting link with *Nautilus Pichleri*, Hauer⁶, which

¹ Waagen, in Palæont. Indica, ser. xiii. vol. i.

² H. Abich, "Eine Bergkalk-Fauna aus der Araxes-Enge bei Djoulfa in Armenien," in geol. Forschung. in den Kaukasischen Ländern, Theil i. 1878.

³ "Die Kalkbrüche von Mjatschkowa," in Nouveaux Mémoires de la Soc. Impér. des Naturalistes de Moscou, tom. xiii. livr. i. 1860, p. 302, tab. xxx. ff. 3a, 3b.

⁴ Mem. Geol. Surv. India—Palæont. Indica, 1879, ser. xiii. Salt-Range Fossils, vol. i. Productus-limestone Fossils. It may be mentioned that *Trautscholdi* is wrongly spelt *Trantscholdi* throughout the book.

⁵ "Eine Bergkalk-Fauna aus der Araxes-Enge bei Djoulfa in Armenien," in geol. Forschung. in den Kaukasischen Ländern, Theil i. pp. 20, 22, Taf. iii., iv. *N. dorso-armatus* is erroneously named *N. tubercularis* on Taf. iv.

⁶ "Cephalopoden der unteren Trias der Alpen," in Sitzungsberichte der k.-k. Akad. d. Wissensch. zu Wien, 1865, 621, Taf. i. ff. 1-3.

is characteristic of the Muschelkalk formation of the Alps, and is on its part again intimately connected with several Upper Triassic species. Another branch, which also very likely takes its origin from the same series of forms, is that composed of *Nautilus Hoernesii*, Stache, *N. crux*, Stache, *N. Sebedinus*, Stache¹, out of the Bellerophon-limestones of the Alps; whilst *Nautilus fugax*, Mojs., recalls again more vividly the form of the shell as it is exhibited by the [geologically] older species, *Nautilus Trautscholdi*, Waagen, *N. transitorius*, Waagen, or *N. Wynnei*, Waagen².

"A species which must also very likely be considered as forming part of the group of *Nautilus Trautscholdi*, but which is somewhat aberrant in its development, is *Nautilus latissimus*³, Waagen, out of the very top beds of the Productus-limestone formation of the Salt-Range. To this species *Nautilus Palladii*, Mojs.⁴, out of the Alpine Muschelkalk, seems to be rather nearly related.

"With these forms, however, the number of species belonging to the *Tuberculati* is yet far from complete. A great many shells belonging to this group have been described from American localities, but all of them seem to belong to developmental series entirely different from those just pointed out among the European and Asiatic species. Only *Nautilus occidentalis*, Shumard⁵ (non Hall), bears a close resemblance to *N. Trautscholdi*, Waagen, and might belong to the same developmental series."

To this series (*Pleuromutilus*) may be added the following species:—*Nautilus (Discites) inopinatus*, Hall⁶, from the Upper

¹ "Beiträge zu Fauna der Bellerophonkalke Südtirols," in Jahrb. d. k.-k. Reichsanst. 1877, Band xxvii. p. 271.

² Mem. Geol. Surv. India—Palæont. Indica, ser. xiii. Salt-Range Fossils, Cephalopoda, 1879, vol. i. pp. 53-55.

³ Ibid. p. 56.

⁴ "Beiträge zur Kenntniss der Cephalopoden-Fauna des alpinen Muschelkalkes," in Jahrb. der k.-k. geol. Reichsanst. 1869, Bd. xix. p. 588, Taf. xviii. f. 3. There appears to be some mistake on the part of Dr. Waagen in comparing his species *N. latissimus* with *N. Palladii*; the latter is a very narrow, laterally compressed form, with the whorls much higher than wide, which is exactly the reverse of the former species. Probably Dr. Waagen intended to refer to *N. Tintoretti*, Mojs. (Taf. xix. of the above memoir), which does resemble *N. latissimus*.

⁵ There is no species of this name described by Shumard. The species referred to is no doubt the *Nautilus occidentalis* of Swallow (non Hall), Trans. Acad. Sci. of St. Louis, 1858, vol. i. no. 2, p. 196 (no figure). The description of this species appears to justify Dr. Waagen's comparison of it with Trautschold's species (*N. tuberculatus*), though the latter was described from an imperfect cast only.

⁶ Geol. Surv. of New York, 1879, Palæont. vol. v. pt. ii. p. 426, pl. cx. ff. 1, 2.

Helderberg Group, near Sandusky, Ohio, which strikingly resembles some of the Triassic species described by Mojsisovics (Med. Triasprov.), and *Nautilus Sangamonensis*, Meek and Worthen¹, from the Upper Coal-Measures of Sangamon County, Illinois.

CARBONIFEROUS SPECIES.

Pleuromutilus falcatus, J. de C. Sowerby, sp.

1840. *Nautilus falcatus*, J. de C. Sowerby, Trans. Geol. Soc. ser. ii. vol. v. pt. iii., Explanation of pl. xl. f. 9; in J. Prestwich, "On the Geology of Coalbrookdale," p. 413 of above volume.

1854. *Nautilus falcatus*, Morris, Cat. British Foss. 2nd ed. p. 308.

Sp. Char. "Discoid, inner whorls exposed; the front convex; sides nearly flat; the outer edge of each whorl obtusely angular, the inner edge inclined towards the preceding whorl, the space between crossed by many arched ribs; septa simply concave: siphuncle central; aperture nearly square, but 6-sided, with two of the sides very small. Length of the aperture 1 inch. Diameter of the shell about $2\frac{3}{4}$ inches." (Sowerby.)

Remarks. This species is remarkable for the quadrate form of the whorls and the inflexions of the sutures. These latter form a deep sinus on the sides of the shell and arching forward upon the lateral angles form an acute backwardly-directed lobe upon the periphery. A somewhat deeply-impressed zone upon the dorsal side of the shell, indicates the amount of overlapping of the whorls. The transverse costæ correspond nearly in number, but not quite in their direction, with the sutures. The latter are nearly 2 lines apart upon the sides of a fragment whose ventro-dorsal diameter is about 8 lines, while in a fragment of the body-chamber of another individual the first septum is only 1 line distant from the base of the body-chamber. The costæ do not pass across the periphery, which is ornamented only with lines of growth, which form a deep backwardly-directed sinus. A faint longitudinal ridge is seen upon casts of the septate part of the shell running along the median line of the periphery. This is one of the "normal lines" (*Normallinie*) described by G. and F. Sandberger (Die Versteinerungen des Rheinisch. Schichtensyst. in Nassau, 1856, p. 41).

A small fragment (registered No. C. 3093), consisting of three

¹ Geol. Surv. of Illinois, 1866, vol. ii. Palæont. p. 386, pl. xxix. ff. 3, 3a, 3b.

septa, probably belongs to a different, though closely allied, species. It is characterized by much wider septa than those of the present species, and the costæ, instead of corresponding nearly with the sutures, are situated between them, much as in *Pleuronautilus distinctus*, Mojsisovics¹, to which the fragment under description bears a by no means remote resemblance. Other features in this fragment are the very acute sinus formed by the sutures upon the periphery, and the tendency of the costæ to become nodose at the margin of the periphery. Should the discovery of more complete specimens confirm my impression that this fossil is undescribed, I would propose that it should be called *Pleuronautilus subdistinctus*.

A species also resembling *P. falcatus* is the *Nautilus Sangamonensis* of Meek and Worthen; but in the latter the sides are concave, and the ornaments consist only of a row of tubercles at the superior lateral angles, there being no costæ. The two species are, however, very closely allied.

Horizon. Coal-Measures.

Localities. Coalbrookdale, Madeley, Shropshire².

Fairly well represented in the Collection. The specimens numbered C. 468 and C. 469 were presented by H. Pearce, Esq.

***Pleuronautilus nodoso-carinatus*, F. Roemer, sp.**

1863. *Nautilus nodoso-carinatus*, F. Roemer, Zeitschr. der Deutsch. geol. Gesellsch. Band xv. p. 577, Taf. xiv. ff. 8, a-c.

1865. *Nautilus (Discites) nodiferus*, Armstrong, Trans. Geol. Soc. Glasgow, vol. ii. pt. i. p. 74, pl. i. ff. 6, 7.

1870. *Nautilus nodoso-carinatus*, F. Roemer, Geologie von Oberschlesien, p. 84, Taf. viii. ff. 19, 20.

1874. *Nautilus nodiferus*, Young and Armstrong, Trans. Geol. Soc. Glasgow, vol. iv. pt. iii. p. 280.

1876. *Nautilus nodiferus*, Armstrong, Young, and Robertson, Cat. of the Western Scottish Fossils, p. 59.

Sp. Char. "Shell discoidal, composed of about three gradually enlarging, contiguous, nearly subquadrate whorls, completely exposed in a moderately shallow umbilicus; back broad, rounded at the edges, and traversed in the middle by a wide and deep channel, on the sloping sides of which are two fine thread-like ridges. The remainder of the space on the back and sides of the shell is

¹ Die Cephalopoden der Mediterranen Triasprovinz (Abhandl. der k.-k. Geol. Reichsanst. Band x.), 1882, p. 278, Taf. lxxv. ff. 4a, 4b.

² See Prestwich's 'Geology,' 1888, vol. ii. pp. 92, 93, small type.

occupied by six rows of closely set, prominent, obtuse tubercles, elongated in the direction of the aperture, one row of tubercles of large size bounding the back, a double row of equal size between it and the channel, and three on the sides, which decrease in size towards the umbilicus. Surface marked with coarse, squamose, wavy lines of growth which are arched backwards in the dorsal [= ventral or peripheral] channel. Septa numerous, their edges arched considerably backwards on the periphery, and slightly so at the sides. Siphuncle $\frac{1}{12}$ inch diameter, central. Dimensions—width of greatest diameter $3\frac{1}{4}$ inches, width of outer whorl near the aperture 1 inch." (*Armstrong*.)

Remarks. There is nothing to be added to the above very accurate description. According to Mr. Armstrong this species belongs in Scotland to the "upper division of the Carboniferous Limestone series of Clydesdale, to which group it would appear to be restricted, no specimens having been observed in any of the lower beds. Good external casts are not unfrequently obtained in the limestones of Castlecary, Arden, and Garnkirk; while one or two entire specimens with the shell preserved have been found in the shale at Gare, near Carlisle. At this locality as well as at the adjoining old workings at Westerhouse, pieces are common which often exhibit the siphuncle and the beautiful shell-markings." There is a fine example of this species in the Museum of Practical Geology.

Roemer institutes a comparison between *Pleuromutilus nodosocarinatus* and *Nautilus Koninckii*, d'Orbigny, but the differences between these species are too obvious to make it necessary to recapitulate them here.

The nodose character of the ornaments is less marked in the German examples of this species than in the Scotch, while, on the other hand, the spiral ornaments are more prominent in the German examples than they are in the latter. I think there can be no question, however, as to the identity of the two forms.

Dr. Roemer's specimens were collected in the Hohenlohe Mine (Franconia), the only locality known to him.

Horizon. Carboniferous Limestone.

Locality. Westerhouse, Lanarkshire.

Represented in the Collection by several fragments having the shell preserved upon them.

TRIASSIC SPECIES.

Pleuromutilus distinctus, Mojsisovics.

1882. *Pleuromutilus distinctus*. Mojsisovics, Die Cephalopoden der Mediterranen Triasprovinz (Abhdl. der k.-k. geol. Reichsanst. Band x.), p. 278, Taf. lxxxv. ff. 4a, 4b.

Sp. Char. Shell planorbiform, consisting of about three very slightly embracing whorls, quadrangular in section, the periphery a little broader than the dorsal side. Umbilicus shallow, very wide, being a little less than half the diameter of the shell. Septa rather numerous, about twenty-two may be counted in the last whorl of a specimen having a diameter of $2\frac{1}{2}$ inches; they are moderately concave and form a shallow sinus upon the periphery. An internal lobe is present. The cast is marked upon the sides with a series of strong ribs (one to each chamber), which are coarsely tubercular upon the edge of the periphery, and fade off at the borders of the umbilicus. Siphuncle situated below the centre. Test unknown.

Remarks. The present species is distinguished from the nearly related *P. semicostatus* by the quadrangular form of its whorls, more rapid rate of increase, and the stronger ribs upon the outer whorl.

Horizon. Trias (zone of *Ceratites trinodosus*).

Locality. Schreyer Alpe, Gosauthal, near Hallstadt, Upper Austria.

Represented in the Collection by a single example.

Pleuromutilus subgemmatus, Mojsisovics.

1882. *Pleuromutilus subgemmatus*, Mojsisovics, Die Cephalopoden der Mediterranen Triasprovinz (Abhdl. der k.-k. geol. Reichsanst. Band x.), p. 277, Taf. lxxxv. ff. 2a, 2b.

Sp. Char. Shell thick, discoid, whorls increasing rapidly in height and thickness, periphery smooth, the lines of growth and fine longitudinal lines crossing them being barely visible under a lens. The sides of the shell, on the contrary, exhibit about five longitudinal ridges crossed by fine lines of growth which impart a granulated appearance to the former at the point of intersection. Periphery broad, surface slightly rounded, sides somewhat flattened, edges of the umbilicus sharply angular; umbilical wall smooth, deep, falling obliquely down to the line of junction of the preceding whorl. The involution follows the line of the outermost of the longitudinal

ridges. An inner lobe is present. The sutures form a broad and deep sinus on the sides of the shell, and make a slight backward curve on the periphery. The siphuncle is situated somewhat below the centre.

Horizon. Trias (zone of *Ceratites trinodosus*).

Locality. Schreyer Alpe, Gosauthal, near Hallstadt, Upper Austria.

Represented in the Collection by a single example.

Genus **TEMNOCHEILUS**, M'Coy¹, emend. Meek².

(*Endolobus*, Meek and Worthen³; *Cryptoceras* (pars), d'Orbigny⁴; *Moniliferi* (pars), Quenstedt⁵; *Ornati* (pars), de Koninck⁶; *Mojsvaroceras*, Hyatt⁷; *Solenoceras* (pars), Hyatt⁸; Group of *Nautilus subtuberculatus*, Waagen⁹.)

Gen. Char. "Shell subdiscoid, with a large, generally deep umbilicus, and a broad flattened or moderately convex periphery; volutions usually little embracing, much widened transversely, and angular, and sometimes subnodose around each prominent lateral margin; septa merely a little arcuate on the margins; surface with only marks of growth." (*Meek.*)

Type, *Nautilus coronatus*, M'Coy¹⁰.

Devonian to Carboniferous.

Remarks. The subgenus *Endolobus* was proposed by Meek and Worthen (*loc. cit.*) "for a large *Nautilus*, not differing very materially in form from species that seem to fall into the group *Temnocheilus* . . . but which is provided with a kind of lobe, or flexure, of the septa on the inner side." This character, however, as Meek goes on to observe, "occurs in other species, which upon all other

¹ Synop. Carboniferous Foss. Ireland, 1844, p. 20.

² Rep. of the United States Geol. Surv. of the Territories, 1876, vol. ix. p. 490.

³ Proc. Acad. Nat. Sci. Philadelphia, 1865, p. 259.

⁴ Prodr. de Paléont. Stratigr. 1849, vol. i. p. 58 (not p. 114).

⁵ Petrefactenkunde Deutschlands, Band i. Abth. i. p. 53.

⁶ Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), 1878, pt. i. p. 90.

⁷ According to Dr. K. A. Zittel, this should be *Mojsisoceras*. Proc. Boston Soc. Nat. Hist. 1883, vol. xxii. p. 269.

⁸ Ibid. p. 286.

⁹ Mem. Geol. Surv. of India—Palæont. Indica, ser. xiii. Salt-Range Fossils, 1879, vol. i. p. 46.

¹⁰ Synop. Carboniferous Foss. Ireland, 1844, p. 20.

characters would fall into several of the different sections." He therefore concludes that *Endolobus* cannot be sustained.

Fig. 23.



Temnocheilus latum.—Lateral view of an imperfect specimen, showing on the left side several of the septa. Drawn from a specimen in the Collection. About one half natural size.

One of the species referred by d'Orbigny to his genus *Cryptoceras* (*Nautilus subtuberculatus*, G. & F. Sandberger, Verstein. Nassau, p. 133, Taf. xii. ff. 3 *a-e*; supposed by Kayser to belong to the genus *Hercoceras*, see *ante*, p. 74), is included by Hyatt in the present group¹. Its ventral siphuncle led d'Orbigny to place it in *Cryptoceras*, but *Nautilus dorsalis*, Phill., has always been taken as the type of that genus (see d'Orbigny, Prodr. de Paléont. Stratigr. 1849, vol. i. p. 114, not p. 58).

Concerning the affinities of *Temnocheilus*, Mojsisovics² observes that it has a superficial resemblance to the genus *Hercoceras*, which has, however, a contracted aperture. Much closer allies, he continues, are to be found in some species of *Gyroceras* (such as *G.*

¹ Proc. Boston Soc. Nat. Hist. 1883, vol. xxii. p. 283.

² Die Cephalopoden der Mediterranen Triasprovinz (Abhandl. der k.-k. Geol. Reichs. 1882, Band x.), p. 266.

devonicans, Barrande¹, *G. validum*, *G. paucinodum*, and *G. transversum*, Hall²), which may be regarded as evolute *Temnocheili*. Whether these are the ancestral forms of *Temnocheilus* or not, the genus is first recognized in the Devonian of Nassau, in the species described by G. & F. Sandberger under the name *Nautilus sub-tuberculatus*, and is well represented in the Carboniferous of England, Ireland, Belgium, the United States, and India. In the first-named country we have *Nautilus tuberculatus*³, J. Sowerby; in Ireland *N. coronatus*⁴, M'Coy. In Belgium the last-named species is recorded by de Koninck⁵ in the Belgian rocks, and he also identifies the *N. (Temnocheilus) latus* of Meek and Worthen⁶.

In the United States several species of *Temnocheilus* have been described from the Coal-Measures of Illinois, among which may be mentioned *Temnocheilus latum*, Meek & Worthen, *T. Winslowi*⁷, M. & W., *T. Coxanum*⁸, M. & W., *T. spectabile*⁹, M. & W.

To these species may be added the "*Discites*" *tuberculatus* of D. D. Owen¹⁰, from the Carboniferous Limestone of Iowa Point, Missouri River, Iowa. The specific name of this species, however, must be changed, because *Temnocheilus tuberculatus* is preoccupied for J. Sowerby's species; I propose, therefore, to substitute for the latter name *Temnocheilus Oweni*.

Dr. W. Waagen¹¹ established three sections for the reception of the *Nautilidæ* of the Productus-Limestone of the Salt-Range, India¹², viz. :—

¹ Syst. Sil. de la Bohême, 1866, vol. ii. pt. i. pl. cexl.

² Nat. Hist. of New York, Palæontology, 1879, vol. v. pt. ii.

³ Mineral Conchology, 1819, vol. iii. p. 90, pl. cexlix. f. 4.

⁴ Synop. Carboniferous Foss. of Ireland, p. 20, pl. iv. f. 15.

⁵ Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. d'Hist. Nat. de Belgique, tom. ii.), pt. i. p. 115, pl. xxiv. f. 2.

⁶ Geol. Surv. of Illinois, 1873, vol. v. Palæont. p. 608, pl. xxx. ff. 2a, 2b.

⁷ Ibid. p. 609, pl. xxxii. ff. 2a, 2b.

⁸ Ibid. p. 543, pl. xxxii. ff. 1a, 1b.

⁹ Ibid. 1866, vol. ii. Palæont. p. 308, pl. xxv. ff. 1a, 1b.

¹⁰ Geol. Surv. of Wisconsin, Iowa, and Minnesota, p. 581, pl. v. f. 14.

¹¹ Mem. Geol. Surv. of India—Palæont. Indica, ser. xiii. Salt-Range Fossils, 1879, vol. i. pp. 42-47.

¹² This great series of rocks is thus subdivided by Dr. Waagen :—

I.—Siliceous-limestone Group.	Upper Productus-limestone.	<div> <div>Topmost Beds.</div> <div>Cephalopoda Bed.</div> <div>Lower Beds.</div> </div>
	Middle Productus-limestone.	<div> <div>Upper Beds.</div> <div>Middle Beds.</div> <div>Lower Beds.</div> </div>
II.—Speckled Sandstone Group.	Lower Productus-limestone.	Speckled Sandstone.
III.—Magnesian Sandstone Group.	Magnesian Sandstone.	Neobolus Beds.

Section I. SIMPLICES.

Naut. peregrinus, Waagen.

Section II. TUBERCULATI.

a. Group of *Naut. subtuberculatus*, Sandberger.

1. *Naut. Flemingianus*, de Koninck.

2. *Naut. Goliathus*, Waagen.

3. *Naut. multituberculatus*, Waagen.

b. Group of *Naut. Trautscholdi*, Waagen.

1. *Naut. transitorius*, Waagen.

2. *Naut. Wynnei*, Waagen.

c. Aberrant species.

1. *Naut. latissimus*, Waagen.

Section III. OPHIONEI.

a. Group of *Naut. ophioneus*, Waagen.

1. *Naut. ophioneus*, Waagen.

2. *Naut. connectens*, Waagen.

3. *Naut. convolutus*, Waagen.

It is only with Group *a* of Section II. that we are at present concerned. This I regard as equivalent to part of *Temnocheilus*, as above defined, and Dr. Waagen's remarks respecting the range of this group in India are of so much interest, that I give them *in extenso* :—

“The oldest species which I am inclined to unite with the *Tuberculati* is *Naut. subtuberculatus*, Sandberger, out of rocks of Devonian age. The characters of the group are, however, not yet

Dr. Waagen is of opinion that these beds, though containing a fauna which in its general aspect is Carboniferous, yet show that the fossils (especially the smaller and less conspicuous ones) are of Permian type, and at last, he says, one arrives at the conviction that the beds contain a Permian fauna “richer in forms and richer in conspicuous species than any that has been described up to the present in the whole world.”

“At the same time,” he adds, “its close relationship to the Carboniferous fauna cannot be denied; and the thought cannot quite be rejected that the singular deviation of the European Permian fauna from the Carboniferous type is caused more by local influence than by a thorough change of the organic life over the whole world, and that in reality the Permian organic life is in by far closer connection with the Carboniferous than was anticipated by Murchison.”

The name “Productus-limestone” can now, adds Dr. Waagen, be applied to the whole series enumerated in the above table, and “be considered as a synonym of ‘Carboniferous’ in the widest sense, if one considers the Permian as nothing but a subdivision of the Carboniferous, as Bunter Muschelkalk is a subdivision of the Trias.”

(Preface to the “Salt-Range Fossils,” ser. xiii. vol. i. 1887, pp. iii–vii.)

well developed in this species, as the tubercles disappear in the older individuals, and an obtuse keel is present on the middle of the ventral part of the shell. The typical form of the species belonging to this group is only exhibited by *Naut. tuberculatus*, Sow., itself, and from it the group can be traced without interruption up to the top of the Palæozoic formations. The species which is most closely allied to the one described by Sowerby is *Naut. tuberculatus*, Verneuil (non Sow.), the distinctness of which species from the true *tuberculatus* has been recognized long since by Prof. Möller, without, however, his introducing a new name for it. It would be convenient to call this species *Naut. Mölleri*, Waagen. Next comes *Naut. Flemingianus*, de Koninck, which is the geologically oldest species of the *Tuberculatus* group occurring in the Salt-range. DeKoninck's original [specimen], which I am in a position to refigure, thanks to the liberality of the Geological Society of London, in whose collection it has been preserved, comes from the middle region of the Productus-Limestone. This is followed by *Naut. goliathus*, Waagen, which species I shall have to describe hereafter; it was found in the lower part of the upper division of the Productus-Limestone. A species which is again very nearly allied to *Naut. Mölleri*, but easily distinguished by the more numerous tubercles, and which also very likely closely resembles young specimens of *Naut. goliathus*, is *Naut. multituberculatus*, Waagen. It is the most recent species of the group in the Salt-range, and was found in beds at the very top of the Productus-Limestone formation. With this species the group of *Naut. subtuberculatus* seems to terminate, as no species, thoroughly allied to the group, has as yet been found in more recent formations."

The above was published (1879) before Mojsisovics' Memoir upon the Cephalopoda of the "Mediterranen Triasprovinz" appeared (1882), in which there is no lack of species whose affinities with those of the group of *Nautilus tuberculati* can be satisfactorily made out. Of these the following may be enumerated, viz., *Temnocheilus Neumayri*, Mojsisovics, *T. Morloti*, Mojs., *T. Cassianus*, Mojs., *T. Augusti*, Mojs.¹, and *T. Schläenbachi*, Mojs.².

The Triassic representatives of *Temnocheilus* have much more embracing whorls than their congeners of the Carboniferous. Some Triassic forms make a very near approach in their squarish whorls

¹ Die Cephalopoden der Mediterranen Triasprovinz (Abhandl. der k.-k. geol. Reichs. 1882, Band x.), pp. 267, 268.

² Das Gebirge um Hallstatt, Band i. p. 12, Taf. ii. f. 1.

and robust habit, as well as in the almost total absence of tubercular ornaments (*T. Morloti*, Mojs., *e. g.*), to Jurassic species, and go far to confirm Professor Hyatt's opinion that *Nautilus excavatus* of the Inferior Oolite is a late survivor of the present series ¹.

CARBONIFEROUS SPECIES.

Temnocheilus tuberculatus, J. Sowerby, sp.

1821. *Nautilus tuberculatus*, J. Sowerby, Mineral Conchology, vol. iii. p. 90, pl. ccxlix. f. 4.
 1836. *Nautilus tuberculatus*, Phillips, Geol. of Yorkshire, pt. ii. p. pl. xxii. ff. 27, 29.
 ? 1844. *Nautilus (Temnocheilus) tuberculatus*, M'Coy, Synop. Carboniferous Fossils of Ireland, p. 22.
 1849. *Nautilus tuberculatus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 111.
 1852. *Nautilus tuberculatus*, Giebel, Fauna der Vorwelt, Band ii. Abth. i. p. 170.
 1854. *Nautilus tuberculatus*, Morris, Cat. of British Fossils, 2nd ed. p. 308.
 1855. *Nautilus tuberculatus*, M'Coy, British Pal. Foss. fasc. iii. p. 562.
 ? 1860. *Nautilus tuberculatus*, Eichwald, Lethæa Rossica, vol. i. Seconde Section de l'Ancienne Période, p. 1315.
 1862. *Temnocheilus tuberculatus*, Griffith, Journ. Geol. Soc. Dublin, vol. ix. p. 33.
 ? 1878. *Nautilus latus*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), pt. i. p. 116, pl. xxiv. ff. 3 a, 3 b, 3 c.
 [Not 1845. *Nautilus tuberculatus*, Murch., Vern., and Keyserl. Géol. de la Russie d'Europe, vol. ii. Paléont. p. 362, pl. xxv. ff. 12 a, 12 b. — 1860. *Nautilus tuberculatus*, Trautschold, Die Kalkbrüche von Mjatschkowa, Hälfte i., in Nouveaux Mém. de la Soc. Impér. des Naturalistes de Moscou, tom. xiii. livr. i. p. 302, tab. xxx. ff. 3 a, 3 b.]

Sp. Char. "Discoid, of one and a half or two whorls commonly preserved, inner whorls very slightly concealed by the following ones; greatest thickness at the edge of the periphery, which is very broad and gently convex, and usually marked along the middle of internal casts by a faint, cord-like, mesial ridge; edges of the periphery broadly flattened, slightly sloped towards the umbilicus, and divided into obtuse tubercles, which are either conoidal or slightly

¹ Proc. Boston Soc. Nat. Hist. vol. xxii. 1883, p. 288.

elongated in the direction of the centre of the umbilicus, beyond this area the inner margin of the umbilicus slopes with slight convexity very rapidly to the tuberculated edge of the preceding whorl about sixteen tubercles on each side of each whorl; the septa moderately convex, the edges moderately concave towards the mouth, both on the sides and periphery, forming a forward rounded angle on the line where the tubercles are placed; siphuncle very large, central; last chamber occupying rather more than one third of the last whorl. Width of mouth eleven lines . . . " (*M'Coy*.)

Remarks. The above is the best description of this species, Prof. M'Coy's specimen being more complete than that of Sowerby, and the former being furnished by Sowerby with "exact measurements and outline of the original specimen," which, adds M'Coy, "agree exactly with our example, in the broadly convex periphery, trace of the medial ridge, &c." M'Coy's specimen was obtained in the Carboniferous shale of Halifax (Yorkshire), where it was rare. The best figure of this species is that of Phillips, but his description is very imperfect.

The type specimen shows very distinctly that the septa are furnished with an internal (dorsal) lobe, which is figured by de Koninck, but not by Sowerby, who seems to have overlooked it in the type.

I have very little hesitation in uniting de Koninck's *Nautilus latus* (not Meek and Worthen's) with the present species, though there is a considerable likeness between *Temnocheilus latus*, M. & W., and *T. tuberculatus*; but the former is flattened and has "two very obscure longitudinal ridges" along the median line of the periphery, and has more quadrangular, less compressed whorls than the latter.

Horizon. Calciferous Sandstone.

Locality. Closeburn, Dumfriesshire.

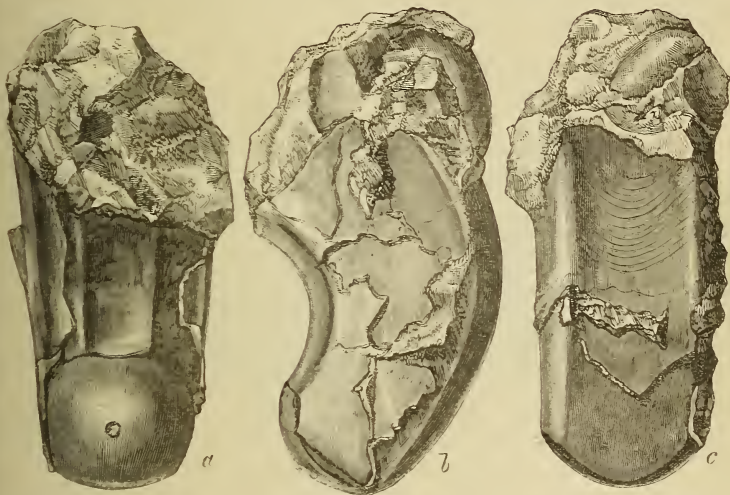
Represented in the Collection by J. Sowerby's type, figured in the 'Mineral Conchology.'

Temnocheilus Cricki, Foord.

Sp. Char. This species is represented only by the body-chamber, but the characters it exhibits are so distinct from those of any other species that one is compelled to regard it as new. The fragment forms a portion of a rather rapidly increasing shell with a broad, flattened, or very slightly concave periphery, bounded by acute lateral angles. The sides, which are about as wide as the periphery, slope a little outwards towards the edge of the umbilicus, where they again form an angle, from which there is a rapid,

slightly concave slope to the point of contact with the preceding whorl, which leaves two very distinct ridges upon the cast. The form of the section is thus, roughly speaking, hexagonal. The

Fig. 24.



Temnocheilus Cricki.—*a*, front view of the body-chamber of an imperfect specimen, showing the position of the siphuncle; *b*, side view, showing the curvature of the specimen; *c*, peripheral view. Drawn from a specimen in the Collection. A little less than one half natural size.

smaller extremity of the fossil shows that the sutures formed rather a deep, backwardly directed sinus upon the sides of the shell, and a V-shaped sinus on the periphery. The siphuncle is situated a little above the centre. The shell is perfectly smooth, there being nothing upon its surface but fine lines of growth. The aperture, which is almost entirely covered by the matrix, probably had a sigmoid outline, with a tolerably deep peripheral emargination, judging by the direction of the lines of growth.

Remarks. This species bears a close resemblance, in its quadrate whorls and form of sutures, to *Nautilus Tschernyschevi*, Tzwetaev¹, but its more rapid rate of tapering and the absence of tubercles separate it completely from that species.

¹ "Céphalopodes de la Section Supérieure du Calcaire Carbonifère de la Russie Centrale," Mém. du Comité Géologique (St. Petersburg), 1888, vol. v. no. 3, pp. 12 and 48, pl. ii. ff. 7-10.

I have much pleasure in naming this fossil after my friend and fellow-worker, Mr. G. C. Crick, Assoc. R.S.M., F.G.S., of the Geological Department in this Museum.

Horizon. Carboniferous Limestone.

Locality. Ireland?

Represented in the Collection by a single example.

Temnocheilus concavus, J. de C. Sowerby, sp.

1840. *Nautilus concavus*, J. de C. Sowerby, in Prestwich's "Geology of Coalbrookdale," Trans. Geol. Soc. ser. 2, vol. v. pt. iii., Explanation of Plates and Woodcuts, pl. xl. f. 6.
 1849. *Nautilus concavus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 111.
 1852. *Nautilus concavus*, Giebel, Fauna der Vorwelt, Band ii. Abth. i. p. 167.
 1854. *Nautilus concavus*, Morris, Cat. British Foss. 2nd ed. p. 307.
 1863. *Nautilus concavus*, F. Roemer, Zeitschr. der Deutsch. geol. Gesellsch. Band xv. p. 576, Taf. xiv. ff. 7 a, 7 b.
 1870. *Nautilus concavus*, F. Roemer, Geologie von Oberschlesien, p. 83, Taf. viii. ff. 21, 22.
 1878. *Nautilus concavus*, Abich, Bergkalkfauna aus der Araxesenge bei Djoulfa in Armenien (Geol. Forschung. in den kaukasischen Ländern), p. 18, Taf. iii. ff. 3, 3 a, 3 b, 4.

Sp. Char. Sowerby gives the following short description of this species:—"Subglobose, umbilicated, concave on the front; septa slightly arched; siphuncle central; umbilicus large; aperture nearly twice as wide as long.

"Length of the aperture 7 lines, width 1 inch.

"Diameter of the shell 1 inch 4 lines.

"The simple curve of the septa and concave front distinguish this species."

Remarks. Most of the examples of this species, both English and German (the latter from the Hohenlohe-Grube and Königs-Grube), are casts of the body-chamber, exhibiting scarcely any trace of ornamentation, except that in some there are faint lines upon the periphery, which indicate a deep sinus in the aperture, and most of the specimens have a faint ridge (normal line) along the median ventral furrow.

Horizon. Coal-Measures.

Localities. Coalbrookdale, Shropshire; Martley, Worcestershire.

Temnocheilus carbonarius, Foord.

Sp. Char. The body-chamber only is preserved, and makes about $\frac{1}{3}$ of a volution. The shell is similar in form, and evidently closely

allied, to *Temnocheilus concavus*, J. de C. Sow., sp. The periphery is very broad and slightly depressed in the centre, the angles rounded, the sides sloping outwards to the edge of the umbilicus, where they are acutely angular, and again sloping steeply to the point of contact with the preceding whorl. The whorls are about double as wide as high. A little below the border of the periphery there are three not very prominent and rather elongated nodes, with faint

Fig. 25.



Temnocheilus carbonarius.—*a*, peripheral view of a very imperfect specimen; *b*, lateral view, showing three or four tubercles. Drawn from a specimen in the Collection. Natural size.

indications of two more towards the aperture. There are obscure traces of lines of growth, which form a somewhat deep sinus upon the periphery. A faint ridge is seen along the median line of the periphery, and numerous fine longitudinal lines may be seen, with the aid of a lens, covering the whole of the surface of the cast. The septa and siphuncle are not preserved.

Remarks. The present species is distinguished from *Temnocheilus concavus* by the absence of the deep ventral furrow characteristic of the latter, and by the possession of a row of nodes along the peripheral border.

Horizon. Coal-Measures.

Locality. Coalbrookdale, Shropshire.

Represented in the Collection by a single example.

***Temnocheilus latus*, Meek and Worthen.**

1865. Cf. *Nautilus nodocarinatus*, McChesney, Illustrations Palæozoic Fossils, pl. iii. f. 6 (5 by error, in explanation of plate). Not *N. nodocarinatus* of same author in text of same paper (1860), p. 66.

1870. *Nautilus (Temnocheilus) latus*, Meek and Worthen, Proc. Acad. Nat. Sci. Philadelphia, p. 49.

1873. *Nautilus (Temnocheilus) latus*, Meek and Worthen, Geol. Surv. of Illinois, vol. v. Palæont. p. 608, pl. xxx. ff. 2a, 2b.

[Not 1878. *Nautilus latus*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), pt. i. p. 116, pl. xxiv. ff. 3a, 3b, 3c.]

Sp. Char. Shell thick, disciform, composed of about two and a half or three volutions, very slightly embracing, and all exposed, forming a very large umbilicus, with apparently a large central vacuity. The section is subquadrangular, much wider than high, the ratio of the two diameters being about 23 to 36. The periphery is broad and flattened, and "has two very obscure longitudinal ridges, with a distinctly flattened space between." The sides are strongly convex and slope abruptly inwards. The septa are 6 lines distant from each other on the sides of the shell, where the ventro-dorsal diameter of the whorl is 21 lines; their sutures form a very shallow sinus on the periphery. The siphuncle is situated close to the margin of the periphery. Along each ventro-lateral margin there is a row of strong prominent nodes, which are exposed upon the inner whorls as well as upon the last; thirteen may be counted on the penultimate whorl.

"The surface is without longitudinal lines, but the striæ of growth are moderately distinct, especially on the broad flattened outer side, where they make a deep backward curve in crossing, so as to indicate the presence of a very deep sinus in the lip on that side of the aperture of the shell. . . . The substance of the shell is thin and scarcely mineralized, though it retains no pearly lustre."

Remarks. The passages between inverted commas in the foregoing description are taken from Meek and Worthen's account of the species. The British Museum specimen being, however, much more perfect than theirs, which was only about half of a volution, I have been enabled to add many particulars of characters which were wanting in the type specimen. (See p. 143, fig. 23.)

This species is closely allied to *Nautilus (Temnocheilus) Winslowi*, Meek and Worthen (Proc. Acad. Nat. Sci. Philadelphia, 1870, p. 50), but the latter has its volutions proportionally narrower, measured at right angles to the plane of the shell. The nodes also are round, instead of being distinctly compressed, as in the present species. These differences may, however, be only of varietal importance. *Temnocheilus latus* has already been compared with *T. tuberculatus*, J. Sowerby, under the description of the latter.

Nautilus acanthicus, Tzwetaev¹, of the Upper Carboniferous rocks

¹ "Céphalopodes de la Section Supérieure du Calcaire Carbonifère de la Russie Centrale," Mém. du Com. Géol. (St. Petersburg), 1888, vol. v. no. 3, pp. 6 and 45, pl. i. ff. 1, 2.

of Central Russia, belongs to the same group of species. It differs from *T. latus* in having less numerous and rounder tubercles and fewer whorls.

Unfortunately there is no record of the locality whence the fine specimen which represents this species in the Collection was obtained, though there is every probability that it came from the Coal-Measures of Illinois. Meek and Worthen's type, it may be mentioned, was obtained at Carbon Cliff, Rock Island County, Illinois.

Temnocheilus Coxanus, Meek and Worthen.

1870. *Nautilus (Temnocheilus) Coxanus*, Meek and Worthen, Proc. Acad. Nat. Sci. Philadelphia, p. 50.
 1873. *Nautilus (Temnocheilus) Coxanus*, Meek and Worthen, Geol. Surv. of Illinois, vol. v. Palæont. p. 543, pl. xxiii. ff. 1 a, 1 b.
 1883. *Kophinoceras Coxanum*, Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 286.

Sp. Char. "Shell rather small, subdiscoid, broadly rounded, or depressed convex over the periphery; umbilicus wide, rather deep, perforated, and showing more than three-fourths of the dorso-ventral diameter of each inner turn; volutions about two and a half to three, very slightly concave along the dorsal or inner side for the reception of the periphery of each succeeding turn within, more or less narrowly rounded (subangular in young specimens), and ornamented by about fifteen small nodes around the middle of each side, from which point the inner side rounds very abruptly into the umbilicus; septa separated on the outer or ventral side by spaces one fifth to one sixth the transverse diameter of the volutions, at the point of measurement, arching slightly backwards in crossing the periphery; body-chamber composing about half of the outer volution; siphuncle small and situated subcentrally, or somewhat nearer the outer or ventral side; aperture transversely oval. Surface ornamented with distinct, regular, longitudinal raised lines, or small revolving costæ, narrower than the rounded furrows between, those along the middle of the ventral or outer side being smaller and more crowded than those towards the lateral regions; crossing all these are numerous very fine crowded striæ of growth, which curve strongly backward in passing over the periphery, parallel to the margins of the very profound sinus in the lip on the ventral side.

"Greatest diameter of a mature specimen 2·23 inches; thickness, or transverse diameter, about 1 inch; dorso-ventral diameter of last turn, near the aperture, 0·86 inch.

"Among the specimens before us there are two forms that may possibly belong to distinct species. One of these, which we con-

sider the typical form of the species here described, has the periphery very depressed convex, while in the other it is distinctly more convex, or rounded. As they agree, however, apparently almost exactly in all other known characters, and both forms seem to vary somewhat in the convexity of the periphery, we are inclined to view them as merely varieties, or probably the different sexes of one species. In the more convex form the lateral nodes seem to be generally a little more inclined to become slightly elongated in the direction of the transverse diameter of the whorls, though this character appears not to be entirely constant. In both forms the longitudinal or revolving surface-ridges and furrows become nearly or quite obsolete toward the aperture on the body-whorl." (*Meek and Worthen*.)

Remarks. The most remarkable feature in this species is the longitudinal ridges which ornament the shell. Professor Hyatt evidently regards this sculpture as possibly indicating affinities with *Gyroceras*, for he places the present species in the same genus (" *Kophinoceras* ") as *Gyroceras ornatum*, d'Arch. & de Vern., though he is rather guarded in his expression of opinion as to its place in the series, for he only says it is "probably in this genus" (" *Kophinoceras* ").

The longitudinal costæ of this species separate it from all others which may resemble it in other respects.

Horizon. St. Louis Limestone (Lower Carboniferous).

Locality. Putnam County, Indiana.

Represented in the Collection by three or four very small specimens partly imbedded in matrix.

Temnocheilus Goliathus, Waagen, sp.

1879. *Nautilus Goliathus*, Waagen, Mem. Geol. Surv. India—Palæont. Indica—ser. xiii., Salt-Range Fossils, vol. i. Productus-Limestone Fossils, p. 50, pl. iv., and Suppl. p. 85.

Sp. Char. "This species is represented by a single complete specimen and a small fragment, but as its form is very characteristic and its geological position well ascertained, it can well be described under a proper specific designation.

"The general form of the shell is that of a very thick disk. The umbilicus is very deep, but not very wide; the whorls are very thick and inflated, with an extremely broad flattened external part [periphery]. The transverse section of the whorls is broad trapezoidal, the broadest diameter being near the outer edge of the whorl. The lateral parts [sides] of the whorls unite with the external part

[periphery] in a rounded edge, which is ornamented with a row of thick elongated rib-like tubercles, extending halfway down the height of the whorl. There are about fifteen of these tubercles on a specimen which has a diameter of 168 mm. The lateral parts [sides] of the whorls slope down from the external edge regularly to the umbilical suture, only showing a slight curve, without forming any umbilical edge or a distinct umbilical wall.

"The septa of this species are slightly curved, like those of the preceding one [*Nautilus Flemingianus*, de Koninck], but they are much less numerous. Besides this, there is no relation between the air-chambers and the tubercles, as is the case in *Naut. Flemingianus*. The specimen I have got for description is not sufficiently well preserved to count the number of septa on each whorl, but there may have been about thirty-two on the last circuit [volution].

"The position of the siphon could not be ascertained. . . .

"*Nautilus Goliathus* is most nearly allied to the species described by de Koninck under the name of *Nautilus Flemingianus*¹, as already noticed more in detail². . . . The differences which exist between the two species . . . consist in the greater thickness of the whorls, the different arrangement of the septa, and the comparatively smaller umbilicus of *Nautilus Goliathus*. From *Nautilus tuberculatus*, Sow., and *Nautilus Mölleri*, W.³, our species is also easily distinguishable by the much smaller umbilicus and the greater thickness of the whorls. Of foreign species only *Nautilus (Endolobus) spectabilis*, Meek and Worthen, bears a certain resemblance, but the transverse section of the whorls in this species is quite different from that in the Indian form." (*Waagen*.)

Remarks. Dr. Woodward having written to Dr. King (Director of the Geological Survey of India) begging that a cast of the figured type of *Nautilus Goliathus* might be made for the British Museum, received a courteous reply from Mr. F. R. Mallet to the effect that the figured type itself had, with the consent of Dr. King, been forwarded⁴; accordingly I am now enabled to compare it with the fine example in the British Museum (No. C. 357).

¹ Mém. sur les Fossiles Paléozoïques recueillis dans l'Inde par M. le Docteur Fleming, &c.: Liège, 1863 (pamphlet), p. 6, pl. viii. ff. 2, 2a. The same paper was communicated also to the Geol. Soc. of London, and published in their Quart. Journ. 1863, vol. xix. pt. i. p. 1, pl. viii. ff. 2, 2a. Described also by Dr. Waagen in the "Salt-Range Fossils" (*loc. cit.* p. 48, pl. iii. f. 2).

² *Ante*, p. 146.

³ = *N. tuberculatus*, de Vern. (non Sow.), Géol. de la Russie d'Europe, vol. ii. pt. iii. Paléontologie, p. 362, pl. xxv. ff. 12a, 12b.

⁴ A cast has been made from this in plaster of Paris, and it is now in the British Museum Collection (No. C. 3071).

I have nothing to add to Dr. Waagen's very exact description of this species, but there is one thing in his figure to which exception must be taken, and that is, that it represents the ribs as being equally well developed upon all parts of the shell. On looking at the type specimen, however, it is seen that the ribs, though strongly developed upon the cast of the first whorl and about half of the succeeding one, become obsolete upon the last half-whorl, including a small portion of the body-chamber. This seems to be the case also in the British Museum example, so far as its eroded surface enables one to judge.

A portion of the test is preserved upon the specimen from the Calcutta Museum. It is nearly 2 lines in thickness, increasing to 3 lines on the ribs. The specimen is crushed out of shape, one side of the periphery being forced beyond the plane of the other side, causing the umbilicus to be deeper on one side than on the other.

Dr. Waagen's figure represents a much more perfect specimen than the original proved to be, having been "restored" to such an extent as to make it quite unrecognizable as a picture of the type specimen. Perhaps his figure was intended rather to represent the aggregate characters of the species than the features of the individual upon which it was founded. It is, however, a matter of some consequence that "type" specimens should be faithfully drawn, so that in case of any difficulty arising as to the identity of a species, reference may be made to the original figure as a trustworthy substitute for the specimen itself.

Many type specimens belonging to collections of historical interest have failed to be identified in consequence of the restoration of the figures representing them. This is the case, for example, with some of the figures in the 'Mineral Conchology,' and also in some of those of the fossils collected by Darwin in the 'Voyage of the *Beagle*.'

The British Museum example is a very large cast, much weathered and broken, but showing on one side nearly the whole of the septate part of the shell and a small portion of the body-chamber, with the very deep umbilicus and remains of the tubercular ridges, which are about as numerous as the septa. About 32 septa may be counted on the last volution, which is the number estimated by Dr. Waagen upon his specimen. The last two septa are 4 lines apart upon the edge of the umbilicus, the others about 5. The following are the principal dimensions of the specimen:—greatest diameter of the shell 9 inches; greatest diameter of umbilicus $3\frac{1}{2}$ inches; greatest height of whorl (ventro-dorsally) 4 inches; greatest breadth of the same $5\frac{3}{4}$ inches.

I am informed by Dr. Woodward that the specimen representing this species in the British Museum Collection was transferred from the India Museum. There is no locality recorded against it in the Register, but as its identity with Waagen's species admits of no doubt, it may safely be inferred that it came from the same locality (as it certainly did from the same horizon) as his fossil.

Horizon. Carboniferous Limestone (Productus-Limestone).

Locality. Salt-Range¹ (Punjab), India.

Temnocheilus ?, sp.

Sp. Char. Fragment of the body-chamber of a rapidly expanding shell (No. C. 2972), the section roughly pentagonal, the ratio of the two diameters as 29 : 26. Periphery broad, slightly hollowed out, angles rounded, sides sloping outwards towards the rounded edge of the umbilicus. The dorsal side with a slight and very narrow median furrow. Siphuncle central.

Judging by the amount of curvature of the inner side the shell had few whorls. Remains of the test adhering to the cast show that it is quite smooth, being marked only with delicate lines of growth. Part of the scar of the shell-muscle is seen at the base of the body-chamber, on the dorsal side, where also a somewhat inconspicuous inner lobe is seen.

Horizon. Carboniferous Limestone.

Locality. Ireland ?

Temnocheilus Freieslebeni, Geinitz.

- 1841. *Nautilus Freieslebeni*, Geinitz, in Leonhard and Bronn's Neues Jahrbuch, p. 637, Taf. xi. ff. 1, *a-c*.
- 1844. *Nautilus Freieslebeni*, de Verneuil, Bull. Soc. Géol. de France, tom. i. sér. ii. p. 510.
- 1848. *Nautilus Freieslebeni*, Geinitz, Die Verstein. des deutschen Zechsteingebirges, p. 6, Taf. iii. ff. 7, *a-c* (same figures as those in the Neues Jahrb. *loc. cit.*).
- 1848. *Nautilus Freieslebeni*, Howse, Cat. of the Fossils of the Permian System of the Counties of Northumberland and Durham, p. 19.

¹ The "Salt-Range" hills form the extreme north-western boundary of the Punjab, between the Indus and Jhelum, and are in the form of a semicircle whose convexity points southward. For full information respecting the geology of this part of India, see 'Manual of the Geology of India' (Pt. I. Peninsula Area), by Medlicott and Blanford, Calcutta, 1879.

1848. *Nautilus Freieslebeni*, King, Cat. of the Organic Remains of the Permian Rocks of Northumberland and Durham, p. 14.
1849. *Nautilus Freieslebeni*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 163.
1850. *Nautilus Freieslebeni*, King, Monograph of the Permian Fossils of England, p. 219, pl. xvii. ff. 13-16, and f. 20 (named in the description of the plate *Nautilus Bowerbankianus*).
1851. *Nautilus Freieslebeni*, Grünewaldt, De Petref. form. calc. cuprif. in Silesia, pp. 10 and 40.
1852. *Nautilus Freieslebeni*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 146.
1854. *Nautilus Freieslebeni*, Morris, Cat. British Foss. 2nd ed. p. 303.
1857. *Nautilus Freieslebeni*, Howse, Ann. Mag. Nat. Hist. vol. xix. p. 43, pl. iv. f. 26.
1861. *Nautilus Freieslebeni*, Geinitz, Dyas oder die Zechsteinformation und das Rothliegende, Heft i. Die Animalischen Ueberreste der Dyas, p. 42, Taf. xi. ff. 7, a-c.
1885. *Nautilus Freieslebeni*, Tschernyschew, Verhandl. der russisch-kaiserlichen Mineralogischen Gesell. zu St. Petersburg, ser. ii. Band xx. p. 268.
1886. *Nautilus Freieslebeni*, Zimmermann, Jahrb. der königl. Preuss. geol. Landesant. und Bergakad. zu Berlin für das Jahr 1885, p. 107.

Sp. Char. Shell deeply umbilicated on both sides, the whorls much broader than high. Periphery broad and flattened, with rounded angles, the sides spreading outwards towards the umbilical margin. The septa are rather distant from each other and form a shallow sinus on the sides and periphery. The siphuncle is situated a little below the centre of the septa. The test, which is thin, is ornamented with delicate lines, which form a backwardly directed sinus upon the periphery. In young examples the test is covered with very fine longitudinal lines, but these become indistinct as age advances, and they finally disappear entirely.

Remarks. Prof. King (Permian Fossils, p. 220) observes that "*Nautilus concavus*, J. de C. Sowerby, of the Carboniferous System, appears to be a closely related species."

Nautilus Freieslebeni is found in England, according to King, in Shell-limestone at Humbleton Quarry, Tunstall Hill, Silksworth, and Dalton-le-Dale (Durham); and in the compact beds at Whitley Quarry (Northumberland). Geinitz records it from the following localities in Germany:—In the Lower Zechstein of Gera (Reuss); in the Kupferschiefer of Milbitz (Schwarzburg-Rudolstadt) and Trebnitz (Silesia); in the Lower Zechstein of Trebnitz, Corbusen (South Altenburg), &c. Large specimens are found in the Lower Zechstein of Ilmenau in the Thüringer Wald, at Selters (Hessen-

Nassau), &c. It is found also at Thalitter in the Grand Duchy of Hesse, according to Sandberger, and Beyrich records it from Logan in Silesia.

Horizon. Permian (Lower Zechstein).

Localities. *British.* Sunderland, Humbleton, Durham.—*Foreign.* Trebnitz¹, near Gera.

TRIASSIC SPECIES.

Temnocheilus Augusti, Mojsisovics.

1882. *Temnocheilus Augusti*, Mojsisovics, Die Cephalopoden der Meditteranen Triasprovinz (Abhandl. der k.-k. geol. Reichsanst. Band x.), p. 267, Taf. xc. ff. 1, 2.

Sp. Char. The whorls are as wide as high, and about one third of their width is covered by the succeeding whorl. The periphery is broad and flattened and bounded at its edges by the obtuse lateral angles; the sides are slightly convex. The edge of the umbilicus is angular and its sides slope obliquely inwards. Nodes are developed both upon the angles bordering the periphery and also upon the edges of the umbilicus, and these two series of nodes are united in the young shell by narrow ribs; but the latter disappear in the adult. The nodes are stronger in the adult than they are in the young stages of growth. The septa are approximate, the sutures forming a moderately deep sinus upon the sides of the shell, and a shallow one upon the periphery. No internal (dorsal) lobe can be seen. Siphuncle situated a little below the centre. The surface of the test appears to be perfectly smooth.

Remarks. The specimens in the Collection, which I have referred to this species, when taken together exhibit nearly all the characters of the species as given in Mojsisovics' diagnosis. The dimensions of the largest specimen are as follows:—

Greatest diameter of shell 5 inches.

Greatest diameter of umbilicus $1\frac{3}{4}$ „

Greatest height (ventro-dorsal) of the whorls $2\frac{1}{2}$ „

Horizon. Muschelkalk.

Locality. Unknown.

Represented in the Collection by two examples (nos. C. 3361-2).

¹ A small village in the Principality of Reuss Gera, Southern Germany.

Temnocheilus bidorsatus, Schlotheim, sp.

1710. *Nautilitis* &c., Buttner, Rudera diluvii testes, p. 271, Paragr. 162, Tab. xxx.
1775. *Nautilites*, &c., Knorr & Walch, Recueil des Monumens des Catastrophes de la Terre, &c. tom. iii. p. 150, Suppl. pl. v. b.
1818. *Nautilus arietis*, Reinecke, Maris protogæi Nautilos et Argonautas, p. 88, pl. x. f. 70.
1820. *Nautilus bidorsatus*, Schlotheim, Die Petrefactenkunde, p. 82, pl. xxxi. ff. 2a, 2b, 2c.
1829. *Nautilus bidorsatus*, Bronn, in Leonhard, Zeitschr. Band i. p. 74.
1830. *Nautilites bidorsatus*, Zieten, Les Pétrifications de Wurtemberg, p. 23, tab. xviii. ff. 1a, 1b, 1c.
1831. *Nautilus bidorsatus*, Münster, Bull. Soc. Géol. de France, tom. i. p. 182.
1832. *Nautilus bidorsatus*, Goldfuss, in von Dechen's translation of De la Beche's Handbook of Geology (Handbuch der Geognosie), p. 456.
1837. *Nautilus bidorsatus*, Bronn, Lethæa Geognostica, Band i. p. 177, tab. xi. ff. 21, a, b.
1849. *Nautilus bidorsatus dolomiticus*, Quenstedt, Petrefactenkunde Deutschlands, Band i. Abth. i. p. 54, Taf. ii. ff. 13a, 13b.
1849. *Nautilus arietis*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 171.
1852. *Nautilus arietis*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 156.
1861. *Nautilus bidorsatus*, Gumbel, Geogn. Beschreib. des bayerischen Alpengebirges und seines Vorlandes (Geogn. Beschreib. des König Bayern), Abth. i. p. 858.
1865. *Nautilus bidorsatus*, Eck, Ueber die Formationen des Bunten Sandst. u. d. Muschelkalks in Oberschlesien und ihre Verstein. p. 141.
1868. *Nautilus bidorsatus*, Terquem et Barré, Descrip. Géologique et Minéralogique du Département de la Moselle par Jacquot, p. 159.
1870. *Nautilus bidorsatus*, F. Roemer, Geologie von Oberschlesien, pp. 135, 146.
1880. *Nautilus bidorsatus*, Eck, Beitrag zur Kenntniss des süddeutschen Muschelkalks, in Zeitschr. der Deutsch. geol. Gesell. Band xxxii. p. 50.
1880. *Nautilus bidorsatus*, Mallada, Boletín de la Comisión del Mapa Geológico de España, vol. vii. Sinopsis de las Especies Fósiles de España, p. 3, pl. i. ff. 1, 2.

Sp. Char. Shell thick, discoid, composed apparently of about $2\frac{1}{2}$ slightly embracing whorls, which are all exposed in a very deep umbilicus. The section is irregularly six-sided, and always more or less wider than high. The periphery is broad and furrowed, and its angles rounded. The sides are compressed and slope a little outwards towards the margin of the umbilicus. The latter has an

angular margin and very steep sides. The septa are somewhat approximate, being about 5 lines apart upon the sides of the shell, where the ventro-dorsal diameter is about 2 inches. The sutures form a shallow backwardly-directed sinus upon the sides and periphery. The body-chamber occupies about half of a revolution. The aperture is deeply emarginate upon the peripheral side. The siphuncle is situated a little below the centre. The test, judging by fragments of it, is ornamented only with lines of growth which from a deep sinus upon the periphery, corresponding with the emargination of the aperture.

Remarks. Some authors have adopted Reinecke's name *arietis* for the present species, on the ground of its priority over Schlotheim's. The former, however, is very incompletely characterized, while the name *bidorsatus* bestowed upon this species by Schlotheim has become so thoroughly engrafted in palæontological literature that it would only be an act of pedantry to change it, merely on the ground of priority, for a name which has not obtained currency. Professor Quenstedt¹ has attempted to show that *Nautilus arietis*, Reinecke, differs from *N. bidorsatus*, Schloth., in the aperture being higher than wide; but this is doubtless an error, probably arising from some mistake in measurement, for there seems nothing to distinguish Reinecke's figure in this respect from those of other authors (making allowance for the foreshortening of the drawing). Schlotheim figures one of the septa, seen in section, and this distinctly shows the superiority of the width over the height of the whorls, and the difference would be even greater were it not that one side of the specimen figured appears to have been somewhat crushed.

Quenstedt distinguished two varieties *Nautilus bidorsatus dolomiticus* (= *N. bidorsatus*, auct.), and *Nautilus bidorsatus nodosus*, Münster. I regard these as distinct species, though Giebel² places the latter in his synonymy of *N. arietis* (= *N. bidorsatus*).

There is a fine specimen of the present species in the British Museum (registered No. 36478) which shows the sinus in the aperture. The greatest diameter of this specimen is $7\frac{1}{4}$ inches.

In describing a species from the Salt-Range of India—*Nautilus latissimus*, Waagen—Dr. Waagen³ observes:—"The full-grown

¹ Petrefactenkunde Deutschlands, 1849, Band i. Abth. i. Cephalopoden, p. 54.

² Fauna der Vorwelt, 1852, Band iii. Abth. i. p. 157.

³ Mem. Geol. Surv. India, 1879—Palæont. Indica—Ser. xiii. Salt-Range Fossils, vol. i. Productus-Limestone Fossils, p. 58.

form of *Naut. latissimus* is very remarkable for a certain similarity to those species of *Nautilus* which have been considered by Quenstedt as forming his group of the *Moniliferi*. If we compare specimens of *Nautilus bidorsatus*, Schlotheim, we find that the general form of the shell agrees pretty well with that of the full-grown shell of *Naut. latissimus*, only the whorls are broader and the outer edge of the whorls is less angular in the latter than in Schlotheim's species. The directly connecting links between the two species, however, are absent, and thus it cannot be ascertained whether we have to deal here really with the ancestor of those Triassic forms or not, but the similarity must not be lost sight of."

Another species having a considerable resemblance to the present one is the *Nautilus canaliculatus* of Cox¹.

Horizon. Muschelkalk².

Localities. Niederbronn, Elsass; Erkerode, Brunswick; Weimar, Saxony; Aach, Württemberg.

Temnocheilus nodosus, Münster, sp.

1831. *Nautilus nodosus*, Münster, Bull. Soc. Géol. de France. tom. i. p. 182.

1832. *Nautilus nodosus*, Goldfuss, in von Dechen's translation of De la Beche's Handbook of Geology (Handbuch der Geognosie), p. 456.

1837. *Nautilus nodosus*, Bronn, Lethæa Geognostica, Band i. 2nd ed. p. 176.

1849. *Nautilus bidorsatus nodosus*, Quenstedt, Petrefactenkunde Deutschlands, Band i. Abth. i. p. 54.

1883. *Solenoceras nodosum*, Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 286.

Sp. Char. This species appears to resemble *Temnocheilus bidorsatus* in every respect except that it is ornamented with a row of strong, flattened nodes along each edge of the periphery. These nodes are described by Quenstedt as being fewer in number than the septa, and more distinct in the young than in the adult period of growth. The lines of growth make a very strong backwardly-directed sinus upon the periphery. Quenstedt adds that the

¹ Geol. Surv. Kentucky, 1857; vol. iii. p. 575, pl. x. ff. 3, 3a.

² The Muschelkalk is separated by the German geologists into three divisions, viz. Lower Limestone (Wellenkalkgruppe), Middle Limestone and Anhydrite (Anhydritgruppe), and Upper Limestone (Hauptmuschelkalk). The middle division, consisting of dolomites with anhydrite, gypsum, and rock-salt, contains very few fossils. *Temnocheilus bidorsatus* occurs both in the Lower and Upper Divisions of the Muschelkalk. See Credner, 'Elemente der Geologie,' 6th ed. 1887, pp. 554-557.

“flattened nodes are a striking feature in almost all the Schwabian [Bavaria] species of *Bidorsati*.” He regards the *Nautilus nodosus* of Münster as undoubtedly the same species.

Remarks. The specimen representing this species in the Collection, though a very much crushed and distorted cast, exhibits some of the nodes at the angles of the periphery, and on one side the septa are laid open and the beaded siphuncle is seen, occupying a position a little below the centre of the septa. The locality of this specimen is unfortunately not known.

Horizon. Muschelkalk.

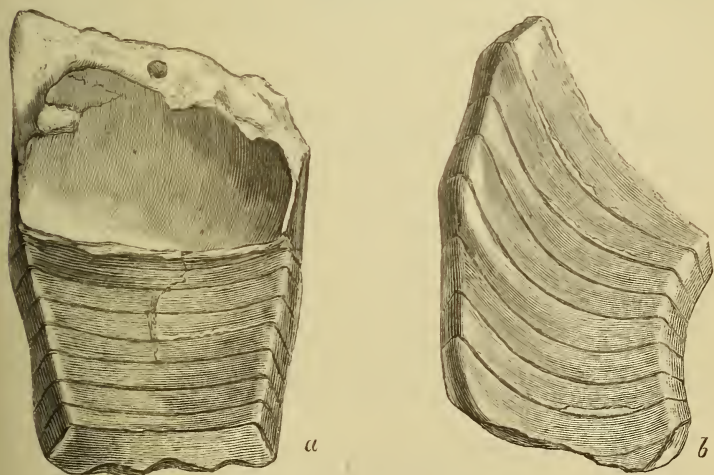
Locality. Unknown.

Represented in the Collection by a very imperfect specimen.

Subgenus **CENTROCERAS**, Hyatt¹.

This subgenus is thus defined by Professor Hyatt:—“*Centroceras* includes a series of Devonian species with much compressed whorls, abdomen [periphery] often hollow, sometimes narrow, with one

Fig. 26.



Temnocheilus (Centroceras) tetragonus.—*a*, front view of the cast of a fragment, showing the position of the siphuncle close to the peripheral margin, and the numerous septa; *b*, lateral view of the same, showing the coarse nodes at the edge of the periphery.

¹ Proc. Boston Soc. Nat. Hist. 1883, vol. xxii. p. 283. The connection between this division and *Temnocheilus* appears to me to be so close that I do not consider that more than a subgeneric distinction between them can be sustained, though Hyatt regards *Centroceras* as a separate genus.

row of tubercles along the edge of the abdomen on either side. The sutures have deep V-shaped ventral lobes, deep lateral, and dorsal lobes; no annular [=internal] lobes in any species observed. The dorsum is frequently gibbous, and has an impressed zone only in the more compressed and involute species. *Centroceras tetragonum*, d'Arch. de Vern. (Trans. Geol. Soc. 1842, ser. ii. vol. vi. p. 351, pl. xxxi. ff. 3, 3a), has young which are identical with adults of *Temnocheilus*, and adults similar to those of typical *Centroceras*, but less compressed."

Type, *Nautilus (Discites) Marcellensis*, Hall¹.

Remarks. It is to be regretted that Professor Hyatt has not indicated what species he would include in this series, besides the two he has mentioned. There appear, however, to be very few forms that could be properly referred to *Centroceras*. To those above named I would add the *Gyroceras binodosum* of G. & F. Sandberger, which is evidently very closely allied to *C. tetragonum*, having the sharply angular nodose whorls and ventral siphuncle characteristic of that species.

The remarkable feature in this genus is the quadrate form of the shell in section and the closeness of the septa. All the European examples of it known are fragmentary.

Temnocheilus (Centroceras) tetragonus, d'Archiac and de Verneuil, sp.

1842. *Cyrtoceratites tetragonus*, d'Archiac and de Verneuil (*Spirula dorsata*, Bonn Museum), Trans. Geol. Soc. ser. ii. vol. vi. p. 351, pl. xxxi. ff. 3, 3a.

1853. *Cyrtoceratites tetragonus*, Steininger, Geogn. Beschreib. der Eifel, p. 41.

1876. *Cyrtoceras tetragonum*, F. Römer, Lethæa geognostica, Theil i. Leth. palæozoica, Atlas, Taf. xxx. ff. 4a, 4b.

1883. *Centroceras tetragonum*, Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 284.

Sp. Char. "Shell quadrangular, slightly arched, presenting longitudinal tubercular folds, with equal interspaces, upon the two outer angles. Inner angles simple. Septa numerous, near together, with undulated edges, concave on each surface and rising toward the aperture at their passage over the angles. Siphon small, sub-

¹ Geol. Surv. of New York, Palæont. vol. v. pt. ii. p. 428, pl. lxxv. ff. 1, 2, pl. cix. ff. 9-12. Also *ibid.*, Supplement (Cephalopoda), 1888, (contained in vol. vii. of the same work, 1888), by C. E. Beecher, p. 39, pl. cxxvi. f. 6, which shows the hollowed-out periphery and ventral siphuncle of this species.

dorsal [close to the periphery]. Shell smooth or only marked with striae of growth." (*d'Archiac and de Verneuil*.)

Remarks. There is only one species with which this may be compared, viz. the *Gyroceras binodosum* of G. & F. Sandberger¹, but this differs essentially from *Centroceras tetragonum* in its ornamentation, which consists of two rows of transversely elongated nodes or tubercles situated on the peripheral angles and separated by a narrow median ridge. The septa are also wider apart in Sandberger's species than they are in the present one. The siphuncle is similarly situated in both.

Horizon. Middle Devonian.

Locality. Gerolstein, Eifel.

Represented in the Collection by a single example, figured above (p. 163, fig. 26).

Genus **SOLENOCHEILUS**, Meek and Worthen², emend.
Hyatt³.

(*Cryptoceras*, d'Orbigny, 1849⁴; *Asymptoceras*, Ryckholt, 1852⁵; *Nautili Globosi* (pars), de Koninck, 1878⁶; "Gruppe des *Nautilus Barandei*," Mojsisovics, 1882⁷; *Asymptoceras*, Hyatt, 1883⁸.)

The description of *Solenochailus* by Meek runs as follows:—"Shell generally presenting the form and surface characters of *Nautilus* proper, but with siphuncle very nearly against the periphery, and the lip on each side drawn out into a narrow spout-like projection.

"Type, *Nautilus (Cryptoceras) Springeri*, White and St. John."⁹
Carboniferous.

¹ Die Versteinerungen des Rheinisch. Schichtensyst. in Nassau, 1856, p. 135, Taf. xii. ff. 4a-4c.

² Proceed. Acad. Nat. Sci. Philadelphia, 1870, p. 47. Also United States Geol. Surv. Terr. 1876, vol. ix. p. 491, from which the description of the genus given here is taken.

³ Proc. Boston Soc. Nat. Hist. 1883, vol. xxii. p. 296.

⁴ Prodr. de Paléontologie Stratigraphique, vol. i. p. 114.

⁵ Notice sur les Genres *Nautilus*, *Vestinautilus*, *Asymptoceras*, &c., p. 6.

⁶ Faune du Calc. Carb. de la Belgique (Ann. du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), pt. i. p. 90.

⁷ Die Cephalopoden der Mediterranen Trias-Provinz (Abhandl. d. k.-k. geol. Reichsanst. Band. x.), p. 288.

⁸ *Op. cit.* p. 296.

⁹ Trans. Chicago Acad. 1868, vol. i. p. 124. *Springeri* is curiously misprinted *spiniger* in Meek's Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country (United States Geol. Surv. Terr. vol. ix. p. 491).

This description of *Solenocheilus* was afterwards emended by Hyatt in the Proceed. Boston Soc. Nat. Hist. vol. xxii. p. 296, and he there restores the name *Asymptoceras*, proposed by Ryekholt, making *Solenocheilus* a synonym. I have stated further on why the name *Asymptoceras* cannot be retained. Hyatt thus describes the group now under discussion :—"The whorls increase very rapidly in size, the living chambers are short, with flaring [*i. e.* spreading outward] or slightly contracted apertures. The venter [periphery] is flattened,

Fig. 27.



Solenocheilus dorsalis.—*a*, lateral view ; *b*, front view ; the inner whorls are slightly distorted. Drawn from Phillips's type specimen in the "Gilbertson Collection." About one half natural size.

or slightly hollow along the centre. The sides are more or less gibbous, and the umbilical shoulders project in heavy ridges, or a large pair of tubercles. Upon each side of these are flutes [channels] which are specially characteristic. The dorsum is also remarkable for having the centre gibbous as in Gyroceran forms, indicating the recent derivation of the genus from more loosely coiled forms. The sutures have broad ventral lobes, saddles at the abdominal [peripheral] ridges, broad lateral lobes, saddles at the umbilical shoulders and dorsal lobes, with small annular lobes [=internal or dorsal lobes]. Siphon near the venter [=ventral or peripheral margin]. . . . The presence of a pair of large tubercles on the chambers of habitation in some of the species unites them with such forms as *Asymp. (Naut.) bifrons*, sp., de Kon. Calc. Carb. pl. 16 [= *Naut. (Solenocheilus) pentagonus*, J. Sow. sp.]. Even the contracted

chamber of this species and of *Asymp. (Naut.) conspicuum*, *ibid.* pl. 19, does not enable us to separate these species."

Remarks. The name *Solenocheilus* of Meek and Worthen replaces that of *Cryptoceras* proposed by d'Orbigny in 1849. The latter was preoccupied by Barrande for a genus of Cephalopoda in 1846, though it was afterwards changed by that author to *Ascoceras*, because Latreille had employed the name *Cryptocerus* for a genus of insects in 1804. However, as Meek¹ observes, the same reason for changing Barrande's name would have equal force in reference to d'Orbigny's, both being anticipated by Latreille's. Referring to American species of *Solenocheilus*, Messrs. Meek and Worthen offer the following remarks:—"In this country we already know several Carboniferous species that agree with d'Orbigny's type in the character or position of the siphuncle, and we find in all of these another remarkable peculiarity of the lip on each side. That is, it is drawn [out] so as to form a kind of little canal, or spout-like channel, much as we see in *Argonauta gondola*, Adams. A good example of one of these shells is figured and described by Dr. White and Prof. St. John, under the name *Nautilus (Cryptoceras) Springeri*, in vol. i. p. 124, of the Transactions of the Chicago Academy of Sciences for 1867²; and this may be regarded as the type of the group. It also includes our *N. (Cryptoceras) Leidyi*³, *N. (Crypt.) capax*⁴, and the species described below [*N. (Solenocheilus) collectus*⁵, M. & W.], with possibly our *N. (Crypt.) Rockfordensis*⁶. . . ."

The genus *Asymptoceras*, established by Ryckholt at the same time (1852) as *Vestinautilus*, already referred to, was very justly rejected by de Koninck upon the same grounds as the latter, viz. that it was founded upon erroneous data. It appears that Ryckholt mistook a calcareous concretion lodged in the body-chamber of a specimen of *Nautilus cyclostomus*, Phill., for one of the mandibles of the animal, and went on to describe the shell as differing from that of the *Nautili* proper by the separation of the last whorl from the preceding ones, and its projection in a nearly straight line, so that the mouth never touches the penultimate whorl. The test appeared to him to be papyraceous, as in the Argonauts; the siphuncle dorsal, as in *N. dorsalis*, Phill. De Koninck states that the speci-

¹ United States Geol. Surv. Terr. 1876, vol. ix. p. 493.

² I have not had access to this work.

³ Proc. Acad. Nat. Sci. Philadelphia, 1865, p. 262.

⁴ *Ibid.* 1865, p. 262. Also in Geol. Surv. of Illinois, 1875, vol. vi. p. 532, pl. xxxiii. ff. 1, 1 a.

⁵ Proc. Acad. Nat. Sci. Philadelphia 1870, p. 48.

⁶ *Ibid.* 1866, p. 275.

men that led Ryckholt into this error may be seen in the Royal Museum of Natural History in Brussels ¹.

CARBONIFEROUS SPECIES.

Solenocheilus Caledonicus, Foord.

[See fig. 30, *infra*, p. 172.]

Sp. Char. Shell subglobose, rapidly expanding, composed of probably two or two and a half whorls, the section being much wider than high. The periphery is rather broadly rounded, slightly depressed along the median line, and sloping outwards to the edge of the umbilicus. Near the edge of the latter, towards the aperture there is a narrow spout-like projection on each side of the shell. The septa are moderately distant, except near the body-chamber, where the last three or four are crowded together. The siphuncle is central. The specimens being all of them casts, nothing is known of the test, but the body-chamber has obscure longitudinal lines upon it, and there is also a "normal line" running down the centre. The ventro-dorsal diameter is to the transverse as 17 : 40.

Remarks. This species finds its nearest ally in *Nautilus* (*Solenocheilus*) *Leidyi*, Meek and Worthen ², but the whorls are much wider in proportion to their height in the present species, which also has a less sinuous form of aperture than Meek and Worthen's shell. The latter is known only by a fragment of the body-chamber, the siphuncle and test being unknown.

Horizon. Upper Limestone Group ³ (Carboniferous Limestone).

Locality. Arden Quarry, Nitshill, near Glasgow.

Fairly well represented in the Collection.

Solenocheilus, sp.

This specimen (No. 39871) is too imperfect for specific identification. It is the fragment of the body-chamber of a rather large and rapidly expanding shell. The periphery is broadly rounded, with a very slight depression along the median line, the sides sloping rather

¹ The valves of *Chiton* occurring in the Carboniferous Limestone have sometimes been mistaken for the mandibles of a Cephalopod. No fossil mandibles (*Rhyncholites*) have, however, yet been discovered in rocks older than the Trias (*Muschelkalk*).

² Geol. Surv. Illinois, vol. v. p. 524, pl. xviii. ff. 2 a, 2 b.

³ For the succession of the rocks of the Carboniferous Limestone series of Scotland, see Part I. of the present Catalogue, p. 121 (footnote).

abruptly towards the umbilicus. The aperture is nearly perfect and presents a moderately deep ventral emargination. The section is much wider than high, the ratio of the ventro-dorsal to the transverse diameter, as nearly as can be computed, being as 40 : 25. The test is rather thick and is marked with numerous irregular lines of growth, traces of which are visible upon the pyritized inner layers of the shell, which also exhibit faint longitudinal lines and punctures, the latter apparently conforming to the direction of the lines of growth. Nothing is seen of the septa or siphuncle.

The species nearest to this form is *Solenocheilus Caledonicus*, but the latter expands more rapidly and there is no indication in the present form of the lateral spout-like projections in the aperture characteristic of *S. Caledonicus*.

Horizon. Coal-Measures.

Locality. Halifax, Yorkshire.

***Solenocheilus dorsalis*, Phillips, sp.**

[See fig. 27, *suprà*, p. 166.]

1836. *Nautilus dorsalis*, Phillips, Geol. of Yorkshire, pt. ii. p. 231, ? pl. xvii. f. 17, pl. xviii. ff. 1, 2.

1843. *Nautilus dorsalis*, Portlock, Geol. of Londonderry, p. 405.

1844. *Nautilus dorsalis* (pars), M'Coy, Synop. Carboniferous Foss. Ireland, p. 23 (var. γ of Phillips).

1849. *Cryptoceras dorsalis*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 114.

1854. *Nautilus dorsalis*, Morris, Cat. of British Fossils, 2nd ed. p. 308.

1875. *Nautilus dorsalis*, Baily, Characteristic British Fossils, p. 117, pl. xl. f. 7.

1876. *Nautilus dorsalis*, Armstrong, Young, and Robertson, Cat. of Western Scottish Fossils, p. 59.

1883. *Asymptoceras dorsale*, Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 297 (footnote).

[Not 1878. *Nautilus dorsalis* (pars), de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), p. 111, pl. xviii. ff. 1 a, 1 b, 2, 3 (? var. γ of Phillips).]

Sp. Char. Shell Nautilus-like, tumid, consisting of about two rapidly enlarging, very involute whorls. Umbilicus very small, though exhibiting the inner whorls; there is a small central perforation.

The septa are wide apart, being about 6 lines distant from each other, where the transverse diameter is 15 lines (type specimen). The siphuncle is close to the peripheral margin. The

surface of the test appears to be smooth, or marked only with very fine and obscure lines of growth. One of the specimens (No. 1693) shows the scar of a portion of the shell-muscle upon the cast of the body-chamber.

Remarks. As Phillips described three species under the name *Nautilus dorsalis*, it is necessary to define them. The first described by him, as var. α , I propose to take as *Nautilus dorsalis*, that being the figured one. Phillips's var. β , with an angular umbilicus, I shall describe under the name *Hibernicus*; while for the third, var. γ , which is probably represented by de Koninck's *dorsalis*, another name would be required. I can find nothing to represent this species among the British Museum specimens.

It was long ago remarked by Portlock¹ that "some of the varieties [of *N. dorsalis*] mentioned by Phillips are really distinct species;" and de Koninck also pointed out the distinctness of Phillips's varieties and regretted that that author had not applied different names to them. The specimen figured by Phillips, now in the British Museum, must, however, be adopted as the type of *S. dorsalis*, and not the variety γ which M. de Koninck selected.

Solenocheilus dorsalis, as now restricted, differs from var. γ in having fewer whorls, smaller umbilicus, and much more distant septa; while it is readily distinguished from *S. Hibernicus* (=var. β) by its rounded, instead of angular umbilicus.

Horizon. Carboniferous Limestone.

Localities. Bolland, Yorkshire; Kildare; Blackrock, Rathfarlane, near Dublin.

Well represented in the Collection, which includes the specimens figured by Phillips in the 'Geology of Yorkshire,' both of which are in the "Gilbertson Collection." Of these No. C. 2971 is here figured (fig. 27).

***Solenocheilus Hibernicus*, Foord.**

1836. *Nautilus dorsalis* (var. β), Phillips, Geol. of Yorkshire, pt. ii. p. 231.

Sp. Char. Shell Nautilus-like, tumid, very rapidly expanding, consisting of about two whorls. The umbilicus deep, with very steep sides, having an angular border (as shown in the figure). There is a large central perforation.

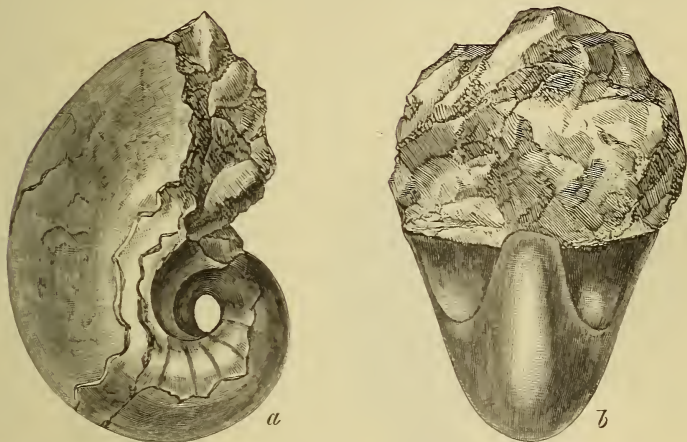
The septa are somewhat wide apart, and the siphuncle is situated

¹ Geology of Londonderry, 1843, p. 405.

close to the peripheral margin. The test appears to have been perfectly smooth.

Remarks. This species is well characterized by the angularity of the umbilical margin, which completely distinguishes it from *S. dorsalis*.

Fig. 28.



Solenocheilus Hibernicus.—*a*, lateral view, showing the large central perforation, the angular margin of the umbilicus, and some of the septa; *b*, front view. Drawn from a specimen in the Collection. Rather less than one half the natural size.

Horizon. Carboniferous Limestone.

Localities. Bolland, Yorkshire; Ireland.

Well represented in the Collection.

***Solenocheilus latiseptatus*, de Koninck, sp.**

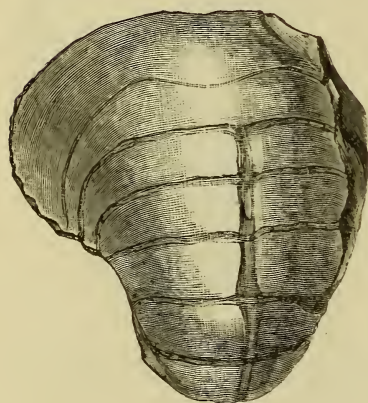
1878. *Nautilus latiseptatus*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Ann. du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), p. 110, pl. xxii. ff. 1-3.

Sp. Char. Shell subglobose, very rapidly expanding, composed of two, or two and a half, whorls. The periphery broadly rounded and sloping rapidly down to the edge of the umbilicus. The umbilicus is large, exposing all the volutions, with a large central perforation. The septa are very wide apart, being about 10 lines distant, just below the body-chamber, the last two septa near the body-chamber being, however, only 7 lines apart. The siphuncle is situated close to the peripheral border, just beneath the test.

This species is only known by casts, therefore the test has not been seen. The impression of the shell-muscles is distinctly seen upon the specimen figured (No. C. 2549).

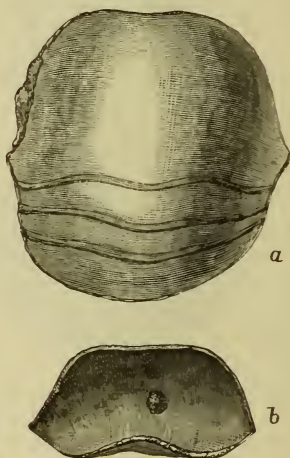
Remarks. Compared with *S. dorsalis*, Phill., sp. (Geol. of Yorkshire, pt. ii. 1836, p. 231, pl. xviii. ff. 1. 2), the present species is found to differ in its much more broadly rounded periphery and wider aperture; the septate portion of the shell is also much larger

Fig. 29.



$\frac{1}{3}$ nat. size.

Fig. 30.



$\frac{1}{3}$ nat. size.

Fig. 29. *Solenocheilus latiseptatus*.—Peripheral view of cast, showing the position of the siphuncle. The thin curved line at the top is the impression of the shell-muscles upon the cast of the body-chamber.

Fig. 30. *Solenocheilus Caledonicus*.—*a*, peripheral view, showing three of the septa; *b*, detached septum, showing siphuncle, not quite in the median line.

These figures (29 and 30) represent specimens in the British Museum.

in proportion to the body-chamber than in Phillips's species, and the septa very considerably wider apart.

Horizon. Upper Limestone Group (Carboniferous Limestone); Calcareous Sandstone.

Locality. Arden Quarry, Nitshill, near Glasgow; Closeburn, Dumfriesshire.

Represented in the Collection by two examples.

Solenocheilus crassiventer, de Koninck, sp.

1878. *Nautilus crassiventer*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), p. 94, pl. ix. ff. 2 *a-c*, 3 *a-c*, 4 *a*, 4 *b*.

Sp. Char. Shell globose, of medium size, having three or four whorls, rapidly increasing, with a very small funnel-shaped umbilicus; the body-chamber occupies half of the last whorl; the aperture is somewhat wider than high, its sides spreading out to a breadth which is double that of the last septum; the sutures of the septa are nearly straight; the septa themselves are only slightly concave, their transverse section is subreniform, their distance from each other could not be ascertained in the Belgian type. The siphuncle is a little transversely elliptical, and is situated close to the external (ventral) border of the shell. The test has been seen in the Belgian example near the edge of the aperture; it is very thin, and its surface quite smooth, showing no traces even of lines of growth. The aperture is strongly emarginate.

Remarks. The specimen in the Collection (No. 2973) referred to the present species has the septa partly exposed in one or two places, and shows them to be half an inch apart where the transverse diameter of the whorl is about two inches.

This species is closely allied to *Solenocheilus dorsalis*, Phill., but it is distinguished therefrom by its smaller umbilicus and its much more ventricose form.

Horizon. Carboniferous Limestone.

Locality. England?

Represented in the Collection by a single example.

Solenocheilus cyclostomus, Phillips, sp.

1836. *Nautilus cyclostomus*, Phillips, Geol. of Yorkshire, pt. ii. p. 232, pl. xvii. f. 29, pl. xviii. f. 3, pl. xxii. f. 26.
 1844. *Nautilus cyclostomus*, de Koninck, Descrip. des Anim. Foss. du Terr. Carbonifère de la Belgique, p. 553, pl. xlv. f. 10, *a*, *b*, pl. xlix. ff. 2, *a*, *b*.
 1844. *Nautilus cyclostomus*, M'Coy, Synop. Carboniferous Foss. Ireland, p. 23.
 1845. *Nautilus cyclostomus*, de Verneuil, in Murchison, de Verneuil, and de Keyserling's Paléont. de la Russie d'Europe, vol. ii. pt. iii. p. 365.
 1847. *Nautilus cyclostomus*, d'Orbigny, Paléont. Universelle, pl. xcix. ff. 6, 7.

1849. *Nautilus cyclostomus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 111.
1852. *Asymptoceras cyclostomus*, Ryckholt, Notice sur les genres *Nautilus*, *Vestinautilus*, &c. p. 6.
1854. *Nautilus cyclostomus*, Morris, Cat. of British Fossils, p. 308.
1860. *Nautilus cyclostomus*, Eichwald, Lethæa Rossica, Seconde Section de l'ancienne Période, vol. i. p. 1317.
1860. *Nautilus cyclostomus*, Griffith, Journ. Geol. Soc. Dublin, vol. ix. p. 56.
1878. *Nautilus cyclostomus*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), p. 112, pl. xxiii. ff. 1 a, 1 b, 2 a, 2 b, 2 c.

Sp. Char. Shell Nautilus-like, composed of three rapidly expanding whorls, which are only just in contact, and all exposed in a moderately deep umbilicus, which has a small central perforation. The initial point is obtuse at its extremity; no cicatrix has been seen upon it. The transverse section is circular. The body-chamber is large and occupies half of the last whorl; it is prolonged for a short distance in adult shells beyond the coiled part. The peripheral border of the aperture is very distinctly emarginate. The septa are tolerably numerous, and consequently not very distant from each other, numbering twenty-one or twenty-two in a complete whorl. The siphuncle is situated on the peripheral margin, and is nearly always of a black colour. The test is extremely thin in all parts of the shell. The ornaments upon its surface in the young shell consist of fine longitudinal thread-like lines, which almost completely disappear when the second whorl is reached, being longest persistent on the ventral side. Lines of growth are also met with, chiefly in the region of the aperture.

Remarks. This species is easily distinguished by the circular form of its section, its non-enveloping whorls, and the ornamentation of the test.

One of the specimens (a fragment of a body-chamber) figured by Phillips (Geol. of Yorkshire, pl. xxi. f. 13) is doubtfully referred by him to the present species, and is described only in the explanation of pl. xxi. thus:—"Part of *Nautilus cyclostomus*?" It most probably belongs to another species, the siphuncle being situated halfway between the centre and the peripheral margin, instead of being quite at the edge of the periphery, as in *S. cyclostomus*.

S. cyclostomus has been found in Ireland, England (Yorkshire), Russia (Ural Mts.), and Belgium.

Horizon. Carboniferous Limestone. Calcaire Carbonifère supérieur, Assise vi. (Belgium).

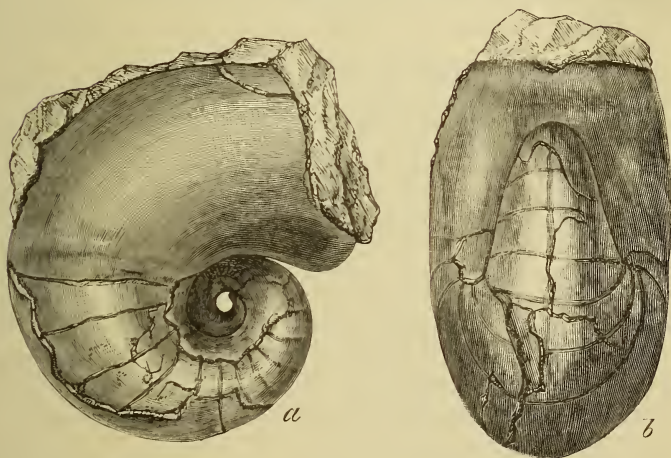
Localities. British. Castleton, Derbyshire.—*Foreign.* Visé, Belgium.

Represented by a fine series of specimens from Belgium, and two of the specimens figured by Phillips in the 'Geology of Yorkshire,' contained in the "Gilbertson Collection."

***Solenocheilus conspicuus*, de Koninck, sp.**

1878. *Nautilus conspicuus*, de Koninck, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii.), p. 109, pl. xix. ff. 1 *a*, 1 *b*, 1 *c*, pl. xx., pl. xxi. ff. 1 *a*, 1 *b*.

Fig. 31.



Solenocheilus conspicuus.—*a*, lateral view, showing the body-chamber with its contracted aperture, and the septate part of the shell from the commencement; *b*, front view. Drawn from a specimen in the Collection. About one third natural size.

Sp. Char. Shell thick, discoid, tumid; composed of about two rapidly increasing whorls, which are all exposed in a small, deep umbilicus, having a small central perforation. The body-chamber occupies about one half of the last whorl, and is a little prolonged beyond the coiled portion; it is inflated at about its mid-length, and becomes very considerably contracted at the aperture, the dorsal side of which presents a characteristic projecting rim. The septa are wide apart, there being only sixteen or seventeen in a complete whorl ending at the base of the body-chamber. The siphuncle is situated close to the ventral margin, just beneath the

test. The surface of the test is perfectly smooth, there being only very faint transverse lines of growth visible upon it. Obscure longitudinal lines are seen upon the cast of the body-chamber in some places, and one of the specimens (Sowerby Coll., No. 43848) shows part of the scar of the shell-muscle very distinctly. Traces of it are also visible upon the specimen figured (No. C. 297).

Remarks. The British examples of this species differ from the Belgian ones, as figured by de Koninck, in having a greater number of septa—twenty-three or twenty-four in a complete whorl, but in other respects the two forms agree.

Horizon. Carboniferous Limestone.

Locality. Kildare, Rathkeale (co. Limerick).

Well represented in the Collection.

***Solenocheilus pentagonus*, J. Sowerby.**

- ? 1809. *Conchyliolithus Nautilites ingens*, Martin, *Petrificata Derbiensia*, p. 17, pl. xli. f. 5.
 1819. *Nautilus pentagonus*, J. Sowerby, *Min. Conch.* vol. iii. p. 89 pl. cexlix. f. 1.
 1836. *Nautilus ingens*, Phillips, *Geol. of Yorkshire*, pt. ii. p. 232, pl. xliii. f. 4.
 1849. *Nautilus pentagonus*, d'Orbigny, *Prodr. de Paléont. Stratigr.* vol. i. p. 111.
 1849. *Nautilus ingens*, d'Orbigny, *ibid.* p. 111.
 1854. *Nautilus ingens*, Morris, *Cat. of British Fossils*, 2nd ed. p. 308.
 1854. *Nautilus pentagonus*, Morris, *ibid.* p. 308.
 1855. *Nautilus ingens*, M'Coy, *British Palæozoic Fossils*, fasc. iii. p. 559.
 ? 1860. *Nautilus ingens*, Eichwald, *Lethæa Rossica*, *Seconde Sect. de l'ancienne Période*, vol. i. p. 1309, pl. xlv. f. 2.
 1874. *Nautilus ingens*, Young and Armstrong, *Trans. Geol. Soc. Glasgow*, vol. iv. pt. iii. p. 280.
 1876. *Nautilus ingens*, Armstrong, Young, and Robertson, *Cat. of Western Scottish Fossils*, p. 59.
 1878. *Nautilus pentagonus*, de Koninck, *Faune du Calcaire Carbonifère de la Belgique* (*Annales du Mus. Roy. d'Hist. Nat. de Belgique*, tom. ii.), p. 106, pl. xiii. ff. 4, 5 a, 5 b.
 1878. *Nautilus bifrons*, de Koninck, *ibid.* p. 114, pl. xv. f. 3, pl. xvi. ff. 1, 2.
 1883. *Asymptoceras bifrons*, Hyatt, *Proc. Boston Soc. Nat. Hist.* vol. xxii. p. 297.
 [Not 1851. *Nautilus ingens*, de Koninck, *Descrip. des Anim. Foss. du Terr. Carbonifère de Belgique* (*Supplém.*), p. 710, pl. lx. f. 1.—
 1878. *Nautilus ingens*, de Koninck, *Faune du Calcaire Carbonifère de la Belgique* (*Annales du Mus. d'Hist. Nat. de Belgique*,

tom. ii.), p. 105, pl. xxiii. f. 4.—1883. *Koninckioceras ingens*, Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 295.]

Sp. Char. Shell thick, discoid, consisting of three or four slightly embracing whorls, all exposed in a wide and deep umbilicus, which has a small central perforation. The sides of the umbilicus slope inwards, and its edge is defined by an obscure angulation, which in the adult shell rises into a coarse ridge on the body-chamber. The periphery in the young shell is simply rounded, but as growth proceeds it becomes obtusely angular along the median line, the angulation again becoming almost obsolete on the body-chamber of full-grown individuals. The section in the young shell is wider than high, the ratio of the two diameters being about as 21:18; in the adult the height and width (owing to the prominence of the lateral angles) are nearly equal. The body-chamber occupies about one half of the last whorl.

The septa are moderately distant, being about 8 lines apart upon the sides of an adult shell, where the diameter is $3\frac{1}{2}$ inches. On the periphery the septa bend slightly forwards in the direction of the aperture, while on the dorsal side they make a very deep backwardly-directed sinus, first making a very sharp (forwardly-directed) angle at each edge of the furrow caused by the overlapping of the whorls. There are indications of an "inner lobe" in one of the specimens in the Collection ("Sowerby Collection"; the specimen numbered 43865 *a*). The siphuncle is nearly central, but a little nearer the inner than the outer margin. The surface of the test is marked with fine, transverse lines of growth.

Remarks. I am quite in agreement with Prof. M'Coy as to the propriety of uniting the *Nautilus ingens* of Martin with the *Nautilus pentagonus* of Sowerby. Prof. M'Coy supports his opinion in the following terms:—

"The examination of a great number of large specimens induces me to propose the union of *Nautilus pentagonus* (Sow.) with this species [*N. ingens*], because out of a great number of specimens with rounded periphery, some have the inner whorls convex on the sides, and the outer ones flattened, and there are all gradations between the broadly rounded periphery of the true *N. ingens* and the keeled exterior of the *N. pentagonus*; but it curiously happens that the two widest extremes which I have seen are at the two ends of one large fragment from Closeburn, which in itself would set the question completely at rest; further, this latter specimen, so strongly keeled in its unseptate portion, shows the impression of simply rounded whorls of the spire on its inner margin."

This latter observation of M'Coy's is completely corroborated by

a fragment of *S. pentagonus* in the British Museum ("Sowerby Collection"; the specimen registered No. 43865 b).

The identity of the fragment of a body-chamber figured by de Koninck (Calc. Carb. pl. xvi. f. 2) under his *Nautilus bifrons* (= *S. pentagonus*, Sow., sp.) is to my mind very doubtful, the convexity of the posterior extremity of the fragment greatly exceeding that of any of the specimens in the British Museum. The large specimen figured upon the same plate is from the collection of Mr. James Thomson, of Glasgow, who lent it to M. de Koninck for illustration. It is so much like one of the specimens in the British Museum Collection (the one numbered 68091 a), that I at first thought that it was identical therewith, until I found that it came from a different locality.

A nearly allied species to the present one is the *Nautilus regulus* of Eichwald, from the Carboniferous Limestone of the neighbourhood of Alexin, in the Government of Kalouga (Lethæa Rossica, *loc. cit.* p. 1308); but this latter species has a broadly rounded periphery in the adult, without any trace of the sharp angle which distinguishes *S. pentagonus* at that stage of growth.

This species attains a very large size. A nearly perfect individual in the British Museum Collection measures 10 inches in its greatest diameter, and a fragment of a still larger specimen 1 foot 1 inch.

Strictly speaking Martin's name *ingens* should have precedence over *pentagonus*, but there is so much uncertainty about the former species that I have thought it best, after carefully examining the specimens at the Jermyn-Street Museum¹, as well as those of the British Museum, to allow Sowerby's name to supersede Martin's.

Horizon. Carboniferous Limestone. Carboniferous Sandstone (Closeburn).

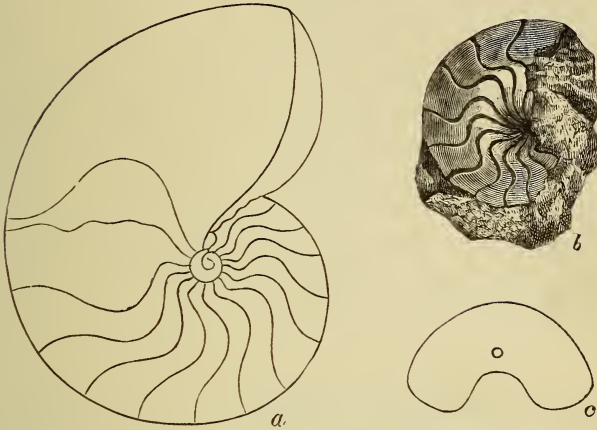
Localities. Bathgate, Linlithgowshire; Closeburn, Dumfriesshire; Arden Quarry, Nitshill, near Glasgow; Derbyshire.

Represented in the Collection by a large number of specimens, including the one figured by Sowerby in the 'Mineral Conchology.'

¹ There are in the Jermyn Street Museum two large specimens from Lancashire labelled *Nautilus ingens*, but they both have an angular periphery, as in *pentagonus*.

Genus **NAUTILUS**¹, Breyn² (restricted).
(*Angulithes*, *Oceanus*, *Bisiphytes*³.)

Fig. 32.



a, *Nautilus pompilius*, outline drawing from an internal cast of the shell⁴, showing the sutures, to compare with those of *b*, *Nautilus (Hercoglossa) Danicus*; *c*, one of the septa of *H. Danicus*, showing the position of the siphuncle.

Figure *a* is about one-third of the natural size; *b* and *c* are of the natural size. Figures *a* and *b* are drawn from specimens in the British Museum Collection; *c*, from a specimen in the collection of Miss C. Birley, of Manchester, kindly lent for illustration.

Gen. Char. Shell discoid, compressed-globose, involute; the um-

¹ The following references to *Nautilus* are of pre-Linnean date:—*Nautilus*, P. Belon, 1553: *De aquatilibus*, libre ii. p. 392. *Cochlea margaritifera vulgo dicta*, G. Rondelet, 1554: *Libri de piscibus marinis*, 97. *Nautilus*, U. Aldrovandi, 1606: *De reliquis animalibus exsanguibus*, liber iii. Cap. iii. p. 257. *Nautilus sive crassus*, G. E. Rumph, 1705: *D'Amboinsche rariteitkamer*, p. 57. *Nautilites*, C. N. Lang, 1708: *Historia lapidum figuratorum Helvetiæ*, p. 101.

² Dissert. Phys. de Polythalamiis, 1732, Cap. vi. p. 12. Some writers quote Linnaeus (Syst. Nat. 1758 (ed. x.), p. 708) as the author of the genus (which has indeed been known since the time of Aristotle), but Breynius was earlier. It would be an endless task to give even the most important of the references that have been made to this well-known genus since the time of Linnaeus; they are to be found in the writings of Bruguière, Cuvier, Lamarck, Sowerby, Deshayes, Owen, Bronn, &c.

³ Conch. systém. 1801, tom. i. p. 55.

⁴ To obtain the cast the shell was longitudinally sectioned, one half filled with paraffin and then immersed in dilute hydrochloric acid, until the shell was completely dissolved.

bilicus closed, or more or less widely open, as in *Nautilus Burtonensis* of the Inferior Oolite and *N. umbilicatus* of the existing seas; volutions deeply embracing and in section rounded, oval, or more rarely angular, as in *N. triangularis* of the Upper Greensand, or even channelled on the periphery, as in *N. hexagonus* of the Oxfordian. Siphuncle variable in position, from central to sub-central. Sutures more or less undulating, sometimes forming tongue-like lobes on the sides (subgenera *Hercoglossa*, *Clydonautilus*). An internal (dorsal) lobe ("annular lobe" of Hyatt) is present in many species, but it has a tendency to become obsolete in the adult shell, and is of no classificatory importance¹. Surface of the test either smooth, or ornamented with longitudinal ridges, or with transverse costæ of varying strength; the latter sometimes divaricating upon the sides and periphery, as in *N. plicatus*. Type, *Nautilus pompilius*, Linné².

Trias to Recent³.

Subgenus **HERCOGLOSSA**, Courad⁴, emend. Meek⁵.

(*Grypoceras*, *Enclimatoceras*, Hyatt⁶, *Aganides*, Zittel⁷ (non Montfort).)

Gen. Char. "Shell more or less discoid, with umbilicus closed or small, and periphery usually rather narrowly rounded⁸; volutions deeply embracing; surface nearly smooth, or with lines of growth; septa deflected backwards in crossing each side, so as to form a deep, usually angular, lateral lobe" (Meek). Type, *Nautilus orbiculatus*, Tuomey⁹.

Trias to Eocene.

¹ It was upon this feature that Montfort founded his genus *Bisiphytes*.—Conch. Syst. 1808, p. 55.

² *Systema Naturæ* (ed. x.), p. 708.

³ For remarks on *Nautilus*, see the Introduction to this volume.

⁴ *American Journ. of Conchology*, 1866, vol. ii. no. 2, p. 101.

⁵ *United States Geol. Surv. Terr.* 1876, vol. ix. p. 491.

⁶ *Proc. Boston Soc. Nat. Hist.* 1883, vol. xxii. pp. 269, 270.

⁷ *Handbuch der Palæontologie*, 1884, Band i. Abth. ii. Lief. iii. p. 383.

⁸ Sometimes flattened, as in *Nautilus (Hercoglossa) franconicus*, Oppel, or even sulcated, as in *N. (H.) Picteti*, Oppel. For other species of *Hercoglossa* see "Die Cephalopoden der Stramberger Schichten," in Oppel and Zittel's 'Palæontologische Mittheilungen,' 1868, Band i. Abth. ii. Atlas, pls. ii., iii., iv. On referring to the 'Catalogue of Scientific Works' published by E. Koch, Stuttgart (1880-1886), we find that this part of the Palæont. Mitth. is erroneously marked, both on the cover and titlepage, "Zweiter Band, Erste Abtheilung," whereas it should be "Erster Band, Zweite Abtheilung."

⁹ *Proceed. Acad. Nat. Sci. Philadelphia*, 1854, p. 167.

Remarks. "*Nautilus Parkinsoni*, Edwards, is cited by Meek as belonging also to *Hercoglossa*. Of this species only two examples are known to us, both from the London Clay—the one figured by Parkinson and also by Edwards, now in the 'Sowerby Collection,' British Museum, the other from Colchester. Both specimens are remarkably large; Parkinson's consists merely of the casts of three chambers, to which a portion of the inner whorls, badly preserved, is attached; the largest chamber is 8 inches in height and 6 inches in width. Owing to the form of the sutures some doubt originally existed as to whether this specimen should not be placed in *Aturia*. Although the siphuncle is cylindrical, as in *Nautilus*, the sutures suggested its being the adult of *Aturia*. Unfortunately the inner whorls are so much crushed that the form of the siphuncle in the young shell cannot be ascertained. The specimen from Colchester, which measures 11 inches in diameter, shows, however, that the siphuncle is cylindrical not only in the adult, but even where the diameter of the shell does not exceed $2\frac{1}{4}$ inches. We feel justified therefore in concluding with Meek that *Nautilus Parkinsoni* belongs to the subgenus *Hercoglossa*, and not to *Aturia*¹. It may here be added that Conrad distinctly states in his description of *Hercoglossa* that the siphuncle is not funnel-shaped [as in *Aturia*], but tubular. He includes in *Hercoglossa* the *Aturia Mathewsoni* of Gabb, though doubtfully, because Gabb did not describe the character or position of the siphuncle in his species, merely stating 'siphuncle large.'

"It is open to question whether *Grypoceras*, Hyatt, should not be merged in *Hercoglossa*; we are inclined to the opinion that it should. Thus the type species of the former (*Nautilus mesodiscus*, Hauer) is distinguished, according to Hyatt, from that of the latter (*N. danicus*, Schloth.) by the presence of a 'V-shaped' ventral lobe in the sutures and by a flattening of the periphery 'at some stage of growth.' Now in some species the ventral lobe, as, *e. g.*, in the type, is perfectly distinct, but in others, as, for instance, *N. Strambergensis*, Oppel, it is so slightly indicated as to approach those species, such as *N. Oppeli*, Zittel, in which there is no such lobe.

¹ Since this was published, part of the outer shell on one side of the specimen has been removed and the inner whorls exposed, the siphuncle exhibiting, to all appearance, a cylindrical form, though the evidence on this point is not perfectly conclusive. The sutural characters, however, are distinctively those of *Aturia*, and therefore *N. Parkinsoni* is now placed in the latter genus, rather than in *Hercoglossa*, to which it was assigned in the joint paper by Mr. G. C. Crick and the writer, referred to at the end of this quotation. See also under the genus *Aturia*, p. 335.

In other species, again, the presence of the lobe is due, in part at least, to the sulcation of the periphery.

"The flattening of the periphery mentioned by Hyatt as also one of the characters of *Grypoceras* is not always accompanied by 'V-shaped ventral lobes,' *Nautilus Picteti*, Oppel, having a flattened and sulcated periphery, but no ventral lobe. The distinction, therefore, between *Grypoceras* and *Hercoglossa* is very difficult to maintain.

"We include also in *Hercoglossa* the genus *Enclimatoceras* of Hyatt¹, type *E. Ulrichi*, White²." (*Foord and G. C. Crick*³.)

Another group closely allied to *Hercoglossa*, is that which has been described (provisionally) by Mojsisovics under the name of *Clydon-nautilus*⁴, of which he has given the following description:—Involute high-mouthed forms with closed, or very small umbilicus, and three sharply-rounded lobes [in the sutures] on the sides of the shell, of which two are much nearer the periphery than the remaining one. In more advanced age the external (peripheral or ventral) lobe is divided by a large saddle-shaped median projection into two separate parts. There is no internal lobe. The siphuncle may be either above or below the centre. The surface of the shell is either reticulated or provided with faint lateral folds or fine ridges. Besides *Clydon-nautilus Noricus*⁵ [the type], the following species are included in this genus, viz.:—

<i>Clydon-nautilus</i>	<i>Quenstedti</i> , F. von Hauer ⁶ .
,,	<i>Salisburgensis</i> , F. von Hauer ⁷ .
,,	<i>securis</i> , von Dittmar ⁸ .
,,	<i>gasteroptychus</i> , von Dittmar ⁹ .
,,	<i>spirolobus</i> , von Dittmar ¹⁰ .
,,	<i>Goniatites</i> , F. von Hauer ¹¹ .
,,	<i>triadicus</i> , E. von Mojsisovics ¹² .

¹ Proceed. Boston Soc. Nat. Hist. 1883, vol. xxii. p. 270.

² Bull. United States Geol. Surv. 1884, vol. i. p. 17, pls. vii., viii., ix.

³ Ann. & Mag. Nat. Hist. 1890, vol. v. pp. 389, 392.

⁴ Die Cephalopoden der Mediterranen Triasprovinz, 1882, p. 281.

⁵ Das Gebirge um Hallstatt, 1873, p. 25, Taf. xi.

⁶ Haidinger's Naturwiss. Abhandl. 1849, Band iii. Abth. i. p. 6, Taf. ii. ff. 1-3.

⁷ Ibid. p. 7, Taf. ii. ff. 4-8.

⁸ Zur Fauna der Hallstädter Kalke, in Geogn.-paläont. Beiträge, 1866, Band i. Heft ii. b, p. 351 (33), Taf. xii. ff. 3, 4.

⁹ Ibid. p. 350 (32), Taf. xii. ff. 1, 2.

¹⁰ Ibid. p. 352 (34), Taf. xiii. ff. 1, 2.

¹¹ Haidinger's Naturwiss. Abhandl. 1849, Band iii. Abth. i. p. 4, Taf. i. ff. 9-11.

¹² Das Gebirge um Hallstatt, in Abhandl. der k.-k. geologisch. Reichsanst. 1873, p. 27, Taf. xiv. ff. 1-4.

Mojsisovics further remarks that the majority of the Mediterranean Trias *Nautili* are distinguished from the Palæozoic *Nautili* by the presence of an inner lobe. This feature is preserved in a great number of Post-Triassic forms up to the present time, *Nautilus pompilius* having it in the young shell.

Pseudonautilus, Meek¹, which has for its type *Nautilus Geinitzi*, Oppel², differs from *Hercoglossa* "in having the septa also provided with a well-defined peripheral and antiperipheral lobe, and the siphuncle placed near the outer margin."

Meek expresses the opinion that *Hercoglossa* "forms a transition from *Nautilus* proper to *Aturia*; that is, it agrees exactly with the former in all respects, excepting in the lobed character of its septa, in which, as well as in form, it agrees still more nearly with the latter; but it nevertheless differs from *Aturia* in having its siphuncle cylindrical and more nearly central, as in *Nautilus*, and not large and funnel-shaped," and, he might have added, close to the internal margin.

It certainly appears that we have in *Hercoglossa* a group of forms whose septal characters differentiate them from the typical *Nautili*, though it must be admitted, as Meek has pointed out, that there are many intermediate gradations to be found among extinct species (*Nautilus Calloviensis*, e. g. fig. 55, p. 234) presenting septa of the *Hercoglossa* type, which show that the latter can hardly be regarded as a distinct genus.

Professor Dr. K. A. von Zittel³ retains the name *Aganides*, Montfort, for *Nautilus Franconicus*, Oppel, &c.; but if the type specimen of Montfort's genus came from Namur, as stated by Montfort, and afterwards by Sonnini⁴, there is a strong probability that it was a *Goniatite*, the rocks in that neighbourhood being of Carboniferous age. It is true that the siphuncle is represented in Sonnini's figure as nearly central, but this might have been a mistake on the part of the artist. It would, at any rate, be impossible to

¹ United States Geol. Surv. Terr. 1876, vol. ix. p. 491. Meek draws attention in a footnote to the very curious and interesting intermediate characters between the *Nautilus* and *Goniatites* groups presented by *Pseudonautilus*. His remarks have already been quoted in this Catalogue (Pt. I., Introd. footnote, p. xviii).

² Zeitschr. der deutsch. geol. Gesell. 1865, Band xvii. p. 546. See also "Die Cephalopoden der Stramberger Schichten," in Oppel and Zittel's Palæontologische Mittheilungen, Band ii. Abth. i. p. 45, Taf. ii. ff. 1-7. *Nautilus aturioides*, Pictet (Mélanges Paléontologiques, 1867, tom. i. livr. ii. p. 63, pl. xi. ff. 1, 2), is regarded by Zittel (Die Ceph. d. Stramberger Schicht. p. 45) as identical with *N. Geinitzi*.

³ Handbuch der Palæontologie, Band ii. p. 383 (1884).

⁴ Hist. Nat. des Mollusques (Montfort's ed. of Sonnini's 'Suite à Buffon'), tom. iv. 1799 (An. x.). p. 253, pl. xlviii. f. 1.

settle this question without a reference to the original specimen, and in the meanwhile it would not be advisable to adopt Montfort's name *Aganides* so long as there is any uncertainty about the type specimen¹.

TRIASSIC SPECIES.

***Nautilus privatus*, Mojsisovics.**

1832. *Nautilus privatus*, Mojsisovics, Die Cephalopoden der Meditteranen Triasprovinz (Abhandl. der k.-k. geol. Reichsanst. Band x.), p. 284, Taf. xc. ff. 3 a, 3 b.

Sp. Char. Shell thick, involute, subquadrangular in section, consisting of about two whorls, about half of the inner being concealed by the outer one. Sides and periphery flattened, the latter narrower than the dorsal side. Umbilicus rather large, measuring one inch in a shell whose diameter is three inches and a quarter. Septa numerous, about twenty to a whorl, the sutures strongly bent backwards on the sides of the shell, nearly straight upon the periphery. An internal lobe is present. Siphuncle situated below the centre. Test smooth?

Remarks. This species is distinguished from *N. quadrangulus*, Beyrich², by the more rapidly increasing whorls (both in thickness and height) and the blunter margins of the umbilicus. The septa also appear to be more numerous in the present form.

Horizon. Upper Muschelkalk (zone of *Ceratites trinodosus*).

Locality. Schreyer Alpe, Gosauthal, near Hallstadt, Upper Austria. Represented in the Collection by a single example.

***Nautilus Suessi*, Mojsisovics.**

1873. *Nautilus Suessi*, Mojsisovics, Das Gebirge um Hallstatt (Abhandl. der k.-k. geol. Reichsanst. Band vi.), p. 26, Taf. vi. ff. 11, a-c; Taf. xiii. ff. 2 a, 2 b.

Sp. Char. Shell inflated, compressed on the sides, narrowly truncated on the periphery, the whorls being thus triangular in section; their greatest width is in the region of the umbilicus; the latter is very small. The periphery is shallowly concave and bordered by two prominent ridges. The septa are approximate, the sutures are slightly bent on the sides of the shell, and form a shallow backwardly directed sinus in crossing the periphery. The ornaments of the test consist of a series of regular, widely

¹ See remarks on the name *Aganides* by Meek (too long for insertion here), United States Geol. Surv. Terr. vol. ix. 1876, p. 494.

² Cephalopoden aus dem Muschelkalk der Alpen, in Abhandl. d. k. Akad. d. Wiss. zu Berlin, 1866, p. 137, Taf. iii. f. 5.

separated, imbricating, transverse striæ, which form a row of nodes on the prominent borders of the periphery. These striæ rise in a gentle, forwardly directed curve from the umbilicus, and are then bent sharply forwards near the periphery. The position of the siphuncle is unknown.

Remarks. This species probably comes nearest to *Nautilus Sauperi*, Fr. v. Hauer¹, but is distinguished therefrom by its strongly marked periphery and the ornaments of the test: from *N. galeatus*, Mojsisovics², it differs in its much broader form, as well as in the ornaments of its test.

Horizon. Upper Muschelkalk.

Locality. Hallstadt.

Represented in the Collection by one young example.

Nautilus Sauperi, Fr. v. Hauer.

1846. *Nautilus Sauperi*, v. Hauer, Cephalopoden des Muschelkalks von Bleiberg in Kärnten, Haidinger's Naturwiss. Abhandl. Band i. p. 26, Taf. i. ff. 1-4.

1847. *Nautilus Sauperi*, v. Hauer, Cephalopoden von Aussee, Haidinger's Naturwiss. Abhandl. Band i. p. 261, Taf. viii. ff. 4, 5.

1866. *Nautilus Sauperi*, Dittmar, Zur Fauna der Hallstädter Kalke (geogn.-paläont. Beiträge, Band i. Heft ii b.), p. 342.

1873. *Nautilus Sauperi*, Mojsisovics, Das Gebirge um Hallstatt (Abhandl. der k.-k. geol. Reichsanst. Band vi.), p. 28, Taf. xiv. ff. 5 a, 5 b, 6; Taf. xv. ff. 1, a-c.

1882. *Nautilus Sauperi*, Mojsisovics, Die Cephalopoden der Meditteranen Triasprovinz (Abhandl. der k.-k. geol. Reichsanst. Band x.), p. 283.

Sp. Char. Shell somewhat inflated, flattened on the sides, narrowly rounded on the periphery in the young shell, but truncated in the adult. The greatest width of the whorls is just above the umbilical region. The narrowing of the shell towards the periphery gives the whorls a subtriangular section. The umbilicus is closed. The septa are rather approximate, the sutures forming a shallow sinus on the sides of the shell and arching strongly forwards: almost straight upon the periphery. The siphuncle is situated below the centre. The test is ornamented with fine lines of growth crossed by fine and regular longitudinal lines.

Remarks. The remarkable character in this species is the change in the form of the periphery, which is rounded in the young shell

¹ Neue Ceph. v. Hallstatt und Aussee, in Haidinger's Naturwiss. Abhandl. i. p. 261, Taf. viii. ff. 4, 5.

² Das Gebirge um Hallstatt (Abhandl. der k.-k. geol. Reichsanst. Band vi.), p. 26, Taf. xii. ff. 1 a, 1 b; Taf. xiii. ff. 1, 3.

and flattened or truncated in the adult. I have already compared *Nautilus Suessi*, Mojs., with this species.

Horizon. Upper Muschelkalk.

Locality. Not recorded, but probably Hallstatt.

Represented in the Collection by a single example.

***Nautilus Simonyi*, Fr. v. Hauer.**

1849. *Nautilus Simonyi*, v. Hauer, Neue Ceph. v. Hallstatt und Aussee, in Haidinger's Naturwiss. Abhandl. Band iii. p. 5, Taf. i. ff. 12-14.

1866. *Nautilus Simonyi*, Dittmar, Zur Fauna der Hallstädter Kalke (geogn.-paläont. Beiträge, Band i. Heft ii b.), p. 342.

1873. *Nautilus Simonyi*, Mojsisovics, Das Gebirge um Hallstatt (Abhandl. der k.-k. geol. Reichsanst. Band vi.), p. 29.

? 1873. *Nautilus modestus*, Mojsisovics, ibid. p. 29, Taf. xv. ff. 2 a, 2 b.

Sp. Char. Shell somewhat compressed on the sides, narrowly rounded on the periphery. Umbilicus very small. Septa approximate, sutures very slightly curved backwards on the sides of the shell, and forming an inconspicuous sinus upon the periphery. Siphuncle very near the dorsal (inner) margin. Test marked only with lines of growth.

Remarks. This species is very closely allied to, if it is not indeed identical with, *N. modestus*, Mojs. (*loc. cit.*), but the latter, according to Mojsisovics, is a more rapidly increasing shell, with a higher aperture. From the appearance of Mojsisovics's figure of *modestus* it seems quite possible that the individual described may have been abnormally compressed, and as it agrees in every essential character with *Simonyi*, I have placed it provisionally in the synonymy of the latter.

Horizon. Upper Muschelkalk.

Locality. Near Hallstatt.

***Nautilus linearis*, Münster, sp.**

1841. *Cyrtocera? linearis*, Münster, Beiträge zur Geognosie und Petrefactenkunde des südöstl. Tirol, p. 125, Taf. xiv. ff. 5, a, b.

1849. *Nautiloceras linearis*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 179.

1869. *Nautilus tertius*, Laube, Fauna der Schichten von St. Cassian (Denkschr. der k.-k. Akad. d. Wiss. Band xxx.), p. 58, Taf. xxxvi. f. 4.

1873. *Nautilus linearis*, Mojsisovics, Das Gebirge um Hallstatt (Abhandl. der k.-k. geol. Reichsanst. Band vi.) p. 14, (footnote).

? 1882. *Nautilus linearis*, Mojsisovics, Die Cephalopoden der Mediteranen Triasprovinz (Abhandl. der k.-k. geol. Reichsanst. Band x.), p. 287, Taf. lxxxiii. f. 5.

Sp. Char. Shell moderately inflated, rapidly tapering; section of whorls nearly circular; septa rather deeply concave; sutures with a conspicuous inner lobe. Siphuncle a little above the centre in the very young shell, but becoming central in the more advanced stages of growth. Surface of the test marked only with fine lines of growth.

Remarks. This is a very badly characterized species, owing to the imperfect condition in which it is found, fragments only being known. The specimen figured by Münster (*loc. cit.*) is only 7 lines in length, that figured by Laube only $5\frac{1}{2}$, but Mojsisovics figures in the 'Ceph. d. Mediterr. Triasprov.' a large fragment, nearly 3 inches in diameter. It seems very questionable whether this belongs to Münster's tiny species, especially as Mojsisovics considers that his specimen is related to *Nautilus Carolinus*, Mojs., and *N. subcarolinus*, Mojs., both of which are very considerably larger than *N. linearis*. The present species is said to be rare.

Horizon. Upper Trias; Cassianer Schichten (St. Cassian Beds).

Locality. St. Cassian, South Tyrol.

Represented in the Collection by a few fragments.

Nautilus (Clydonautilus) spirolobus, Dittmar.

1866. *Nautilus spirolobus*, Dittmar, Zur Fauna der Hallstädter Kalke (in geognost.-paläontol. Beiträge, Band i. Heft ii. b), p. (34) 352, Tab. xiii. ff. 1, 2.

1869. *Nautilus Goniatites* (Hauer), Mojsisovics, Gliederung der oberen Triasbildungen, Jahrb. Geol. R. A. p. 95.

1873. *Nautilus spirolobus*, Mojsisovics, Das Gebirge um Hallstatt (Abhandl. der k.-k. geol. Reichsanst. Band vi.), p. 28.

Sp. Char. Shell Nautilus-like, involute, inflated, rapidly increasing in height and thickness. Umbilicus closed. Greatest thickness, which exceeds the height, at the umbilicus. The septa are somewhat numerous, the sutures are much bent upon the sides of the shell, forming a deep and wide lateral backwardly directed lobe, and a smaller one (directed forwards) in the umbilical region. Again, on the periphery there is a deep and narrow backwardly directed lobe.

The test is covered with fine but distinct transverse raised lines or ridges, which form a slight sinus in the median line of the periphery, showing the shape of the emargination of the aperture.

A peculiar feature in this species is that each suture touches the preceding one at a point near the border of the periphery, the sides of the lobes thus joined having the appearance of a continuous line running longitudinally on each side of the peripheral lobe. This feature is common to all stages of growth.

Remarks. The species most nearly related to *N. spirolobus* are *N. Sauperi*, Hauer, *N. Goniatites*, Hauer, and *N. reticulatus*, Hauer. From the first two *N. spirolobus* is distinguished by the character of

Fig. 33.



Nautilus (Clydonautilus) spirolobus.—*a*, lateral view, showing some of the sutures on the left-hand side of the figure, where the test is absent; *b*, peripheral view, showing the sinus in the transverse ridges in the median line. Parts of the sutures (ventral lobes) are seen at the bottom of the figure. Drawn from a specimen in the Collection. About one-half natural size.

its sutures, and from the last by its more involute and inflated whorls.

Horizon. Upper Muschelkalk (Zone of *Ceratites trinodosus*).

Locality. Somerau Kogel¹, near Hallstadt, Upper Austria.

***Nautilus (Clydonautilus) Quenstedti*, Fr. v. Hauer.**

1849. *Nautilus Quenstedti*, v. Hauer, Neue Ceph. v. Hallstatt und Aussee, in Haidinger's Naturwiss. Abhandl. Band iii. p. 6, Taf. ii. ff. 1-3.

1866. *Nautilus Quenstedti*, Dittmar, Zur Fauna der Hallstädter Kalke (geogn.-paläont. Beiträge, Band i. Heft ii. b), p. 342.

1873. *Nautilus Quenstedti*, Mojsisovics, Das Gebirge um Hallstatt (Abhandl. der k.-k. geol. Reichsanst. Band vi.), p. 22, Taf. ix. ff. 1 a-c, 3.

1882. *Clydonautilus Quenstedti*, Mojsisovics, Die Cephalopoden der Mediterranen Triasprovinz (Abhandl. der k.-k. geol. Reichsanst. Band x.), p. 281.

¹ Kofel or Kopf, the cone-like or sugar-loaf summit of a mountain.

Sp. Char. Shell compressed on the sides and narrowly truncated on the periphery, the whorls thus presenting a triangular section, the base of the triangle being the dorsal (inner) side of the shell. The periphery is shallowly concave and bounded by two prominent ridges. The greatest width of the whorls is in the region of the umbilicus. The latter is very small. The septa are approximate; the sutures form two prominent lobes directed towards the aperture and separated by a deep and narrow sinus. The broader of the lobes is situated in the region of the umbilicus, the narrower one near the peripheral margin. A shallow sinus is formed by the sutures in crossing the periphery. The siphuncle is not known. The test is ornamented with thick and somewhat obscure and distant transverse, falciform folds, which form a sort of elbow at about the middle of the sides of the shell, their convexity being directed forwards, not backwards as in some species of Ammonites having similar ornaments (e. g. *Harpoceras falciferum*).

Remarks. A fine example of this species is figured by Mojsisovics¹, in which the test is very well preserved. The species which is nearest to the present one is *Nautilus (Clydonautilus) Salisburgensis*, v. Hauer²; but the latter is a flatter shell with a much narrower periphery, the sutures also are more sharply bent than they are in *Naut. (Clydonautilus) Quenstedti*.

Horizon. Upper Muschelkalk.

Locality. Hallstadt.

Represented in the Collection by a fragment (No. 22485).

JURASSIC SPECIES.

Nautilus striatus, J. Sowerby.

1817. *Nautilus striatus*, J. Sowerby, Min. Conch. vol. ii. p. 183, pl. clxxxii.

1820. *Nautilus aratus*, Schlotheim, Die Petrefactenkunde, p. 82.

1829. *Nautilus striatus*, De la Beche, Trans. Geol. Soc. ser. ii. vol. ii. p. 27.

1830. *Nautilus giganteus* (Schübler), Zieten, Les Pétrifications de Wurtemberg, livr. i. p. 23, tab. xvii. ff. 1 a-c, & f. 2.

? 1836. *Nautilus aratus*, Roemer, Die Versteinerungen des Norddeutschen Oolithen-Gebirges, p. 178.

¹ Das Gebirge um Hallstatt (Abhandl. der k.-k. geol. Reichsanst.), Band vi. 1873, p. 22, Taf. ix. ff. 1 a, 1 b.

² Neue Ceph. v. Hallstatt und Aussee, in Haidinger's Naturwiss. Abhandl. iii. p. 7, Taf. ii. ff. 4-8.

1837. *Nautilus aratus*, v. Buch, Akad. der Wissenschaften, p. 80.
1839. *Nautilus striatus*, De la Beche, Mem. Geol. Surv. : Report on the Geology of Cornwall, Devon, and West Somerset, p. 224.
1842. *Nautilus striatus*, d'Orbigny, Paléontologie Française (Terrains Jurassiques), tom. i. p. 148, pl. xxv.
1843. *Nautilus aratus*, Quenstedt, Das Flötzgebirge Württembergs, p. 134.
1845. *Nautilus striatus*, Murchison, Outline of the Geology of the Neighbourhood of Cheltenham (New ed. augmented and revised by James Buckman and H. E. Strickland), Appendix, p. 91.
1846. *Nautilus aratus*, Schmidt, Petrefacten-Buch, p. 57, Taf. xviii. ff. 1 a, 1 b.
1849. *Nautilus aratus*, Quenstedt, Die Cephalopoden, p. 55, Taf. ii. f. 14.
1849. *Nautilus striatus*, d'Orbigny, Prodrome de Paléontologie Stratigraphique, vol. i. p. 211.
1850. *Nautilus striatus*, Coquand and Bayle, Bull. Soc. Géol. de France, sér. ii. vol. vii. p. 235.
1852. *Nautilus striatus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 165.
1854. *Nautilus striatus*, Morris, Catalogue of British Fossils, 2nd ed. p. 307.
- ? 1855. *Nautilus striatus*, Simpson, The Fossils of the Yorkshire Lias, p. 32.
- ? 1855. *Nautilus annularis*, Simpson, ibid. p. 33.
1857. *Nautilus striatus*, Etheridge, in Mem. Geol. Surv. of Great Britain—Hull, On the Geology of the country around Cheltenham, p. 23.
1858. *Nautilus aratus*, Quenstedt, Der Jura, p. 72, Taf. viii. f. 11.
1858. *Nautilus striatus*, Ooster, Catalogue des Céphalopodes Fossiles des Alpes Suisses, pt. iii. p. 3.
1858. *Nautilus striatus*, Oppel, Die Juraformation : Englands, Frankreichs und des südwestlichen Deutschlands, p. 73.
1858. *Nautilus aratus*, Chapuis, Nouvelles Recherches sur les Fossiles des Terrains Secondaires de la Province de Luxembourg (Extrait du tome xxxiii. des Mémoires de l'Académie Royale de Belgique), p. 11, pl. ii. ff. 1 a, 1 b, ? 1 e, 1 f.
1860. *Nautilus striatus*, Wright, Quart. Journ. Geol. Soc. vol. xvi. pp. 399, 405, 407.
1864. *Nautilus striatus*, Eudes-Deslongchamps, tudes sur les Etages Jurassiques Inférieurs de la Normandie, p. 25.
1866. *Nautilus striatus*, Brauns, Palæontographica, Band xiii. p. 85.
1867. *Nautilus striatus*, Dumortier, Études Paléontologiques sur les Dépôts Jurassiques du Bassin du Rhône, pt. ii. pp. 19 & 112 ; ibid. 1869, pt. iii. p. 212.
1868. *Nautilus striatus*, Terquem and Barré, Description Géologique et Minéralogique du Département de la Moselle, par Jacquot, p. 233.

1871. *Nautilus striatus*, Phillips, Geology of Oxford and the Valley of the Thames, p. 131.
1872. *Nautilus striatus*, Blake, Quart. Journ. Geol. Soc. vol. xxviii. p. 141.
1875. *Nautilus striatus*, Phillips, Geology of Yorkshire, 3rd ed. pt. i. p. 263.
- ? 1875. *Nautilus annularis*, Phillips, *ibid.* p. 263, pl. xii. f. 18.
1876. *Nautilus striatus*, Blake, in Tate and Blake's The Yorkshire Lias, pt. ii., Palæontology, p. 312.
1878. *Nautilus striatus*, Judd, Quart. Journ. Geol. Soc. vol. xxxiv., Table facing p. 736.
1881. *Nautilus striatus*, Gosselet, Esquisse Géologique du Nord de la France, fasc. ii. p. 184.
1882. *Nautilus striatus*, Etheridge, Quart. Journ. Geol. Soc. (Proceedings—Anniversary Address), vol. xxxviii. p. 171.
1883. *Nautilus striatus*, Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 302.
1884. *Nautilus striatus*, L. Mallada, Bol. Com. del Mapa Geol. de España, vol. xi. Sinopsis de Fósiles de España, p. 19 (figured *ibid.* vol. v. 1878, pl. iii. f. 3).
1888. *Nautilus striatus* (?), Beeby Thompson, The Middle Lias of Northamptonshire, p. 54.

Sp. Char. "Slightly depressed; umbilicate; concentrically striated; aperture half the diameter of the shell, nearly orbicular." (*Sowerby*.)

Remarks. To the above short description *Sowerby* adds the following:—"Whorls rather gibbose, they are few, and increase rapidly; the umbilicus is large, exposing a small part of the inner whorls; the numerous striæ which cover the surface are irregular, elevated, and so strong that they might almost be considered as ridges; the front is a little compressed, giving the aperture a squarish form."

Dumortier states that this species is found pretty abundantly in the "*Ammonites Bucklandi* zone," in the Lower Lias of the Rhone Basin; but it is badly preserved.

Chapuis (*loc. cit.*) adopts the name *Nautilus aratus* (*Schlotheim*) for this species, and (following *Quenstedt*) distinguishes three varieties of it, A, B, and C; the first (A) being the *Nautilus striatus*, *J. Sowerby*, the second (B) *Nautilus semistriatus*, *d'Orbigny*, and the third (C) *Nautilus intermedius*, *J. Sowerby*. But the characters distinguishing these three forms may well be regarded as of specific value. The present species differs from *N. intermedius* and *N. semistriatus* by its uniformly rounded and uncompressed whorls, and again from the last-named species by its larger umbilicus and persistent striæ.

Professor Blake¹, who examined the type of Phillips's *N. annularis*, considered it to be only a variety of *N. striatus*.

The ornamentation of the test of *N. striatus* is remarkably beautiful; it consists of a series of tolerably regular, wavy, longitudinal ridges, about three in the space of a line, covering the whole surface of the shell, one or two fine lines occupying the space between two of the ridges. Fine lines of growth cross the ridges, cutting them into a number of minute crenulations. Some of the lines of growth are raised into coarse folds on the sides of the shell, beginning in the umbilicus, but they become nearly obsolete upon the periphery and die out altogether in the adult shell. In the latter the sculpture becomes very coarse, the longitudinal ridges being now from one to nearly two lines distant from each other, the interspaces being occupied by fine lines, as in the younger shell. The ridges vary in strength in all stages of growth, finer ones being intercalated among the coarser.

The ornamentation of the adult shell may be well seen in the specimen numbered C 1941. There is a conspicuous internal (dorsal) lobe in the sutures of the septa.

N. striatus is recorded by Tate and Blake² from the following localities in Yorkshire:—Zones of *Ammonites planorbis*, Cliff; *A. angulatus*, Cliff, Redcar, Eaton Pitt; *A. Bucklandi*, Redcar, Marske, Ellerbeck. The species referred to in some of these localities is probably the *N. astacoides* of Young and Bird (q. v.).

Horizon. Lower Lias.

Localities.—*British.* Lyme-Regis, Dorsetshire; Tewkesbury, Cheltenham, Gloucestershire; Bugbrook, Northamptonshire.—*Foreign.* Filder, Degerlock, near Stuttgart, Wurtemberg; Randen, near Schaffhausen, Switzerland.

The Collection contains several very fine specimens, including one of Sowerby's original types (the specimen numbered 43852 *a* in the Sowerby Collection), and a specimen (No. 18) presented by Sir H. De la Beche.

***Nautilus intermedius*, J. Sowerby.**

1816. *Nautilus intermedius*, J. Sowerby, Min. Conch. vol. ii. p. 53, pl. cxxv.

1830. *Nautilus squamosus* (?), Zieten, Les Pétrifications de Wurtemberg, livr. i. p. 24, tab. xviii. ff. 3, *a-c*.

¹ Tate and Blake, 'The Yorkshire Lias,' 1876, p. 312.

² Ibid.

1830. *Nautilus dubius*, Zieten, *ibid.* p. 24, tab. xviii. ff. 4, a-c.
1839. *Nautilus intermedius*, De la Beche, *Mem. Geol. Surv. ; Report on the Geology of Cornwall, Devon, and West Somerset*, p. 224.
1842. *Nautilus intermedius*, d'Orbigny, *Paléontologie Française (Terrains Jurassiques)*, tom. i. p. 150, pl. xxvii.
1845. *Nautilus intermedius*, Murchison, *Outline of the Geology of the Neighbourhood of Cheltenham* (new ed.), Appendix, p. 91.
1849. *Nautilus aratus numismalis*, Quenstedt, *Die Céphalopoden* p. 56.
1849. *Nautilus intermedius*, d'Orbigny, *Prodrome de Paléontologie Stratigraphique*, vol. i. p. 223.
1852. *Nautilus intermedius*, Giebel, *Fauna der Vorwelt*, Band iii. Abth. i. p. 163.
1853. *Nautilus affinis*, Chapuis and Dewalque, *Description des Fossiles des Terrains Secondaires de la Province de Luxembourg* (Extrait du tom. xxv. des *Mém. de l'Acad. Roy. de Belgique*), p. 34, pl. iii. ff. 4 a, 4 b.
1854. *Nautilus intermedius*, Morris, *Catalogue of British Fossils*, 2nd ed. p. 307.
1858. *Nautilus intermedius*, Ooster, *Catalogue des Céphalopodes Fossiles des Alpes Suisses*, pt. iii. p. 4.
- ? 1858. *Nautilus intermedius*, Chapuis, *Nouvelles Recherches sur les Fossiles des Terrains Secondaires de la Province de Luxembourg* (Extrait du tom. xxxiii. des *Mémoires de l'Académie Royale de Belgique*), p. 13, pl. ii. ff. 1 c, 1 d.
1866. *Nautilus intermedius*, Falsan and Locard, *Monogr. Géologique du Mont d'Or Lyonnais*, p. 255.
1869. *Nautilus intermedius*, Dumortier, *Études Paléontologiques sur les Dépôts Jurassiques du Bassin du Rhône*, pt. iii. p. 55.
1871. *Nautilus intermedius*, Phillips, *Geology of Oxford and the Valley of the Thames*, p. 131.
1873. *Nautilus intermedius*, Collenot, *Description Géologique de l'Auxois*, p. 270.
1876. *Nautilus intermedius*, Blake, in Tate and Blake's 'The Yorkshire Lias,' pt. ii. *Palæontology*, p. 312.
1881. *Nautilus intermedius*, Gosselet, *Esquisse Géologique du Nord de la France*, fasc. ii. p. 184.
1882. *Nautilus intermedius*, Etheridge, *Quart. Journ. Geol. Soc. (Proceedings—Anniversary Address)*, vol. xxxviii. p. 171.
1883. *Cenoceras intermedium*, Hyatt, *Proc. Boston Soc. Nat. Hist.* vol. xxii. p. 301.
1884. *Nautilus intermedius*, L. Mallada, *Bol. Com. del Mapa Geol. de España*, vol. xi. *Sinopsis de Fósiles de España*, p. 19. (Figured *ibid.* vol. v. 1878, pl. iii. ff. 7, 8.)

Sp. Char. "Gibbose, umbilicate, concentrically striated; back broad, flattened; mouth squarish; siphuncle nearest the external edge." (*Sowerby.*)

Remarks. The shell is thick-discoid, slightly compressed at the sides and flattened upon the periphery. The umbilicus is of moderate size and exposes the inner whorls. The siphuncle is situated a little above the centre. The septa are somewhat distant, and the sutures are slightly sinuated in crossing the periphery. The ornaments consist of very distinct and regular longitudinal ridges which are crossed by a few irregular lines of growth.

This species is distinguished from *N. striatus* by its squarish and more robust form and by the flattening of the periphery; and from *N. semistriatus* by the former character, as well as by the superior size of the umbilicus, and the persistency of the ornaments of the test. From *N. obesus*, J. Sowerby, and *N. truncatus*, J. Sowerby, the present species may be distinguished by its open umbilicus.

M. Chapuis¹ has figured this species, or something very near to it, under the name *N. aratus*, var. C, as previously noted; but his figure, though agreeing in its ornamentation with Sowerby's *N. intermedius*, represents a more compressed shell with much closer septa. Such a form is met with in the Collection in the shape of a cast from Randen, near Schaffhausen, which has rather close septa, a narrow and very flat periphery, and somewhat flattened sides. It is questionable, however, whether this form can be regarded as identical with the *N. intermedius* of Sowerby, and the evidence which would connect it with Chapuis's fossil is not quite complete, owing to the absence of the test.

Another cast (No. C. 484), the locality of which is unknown, appears to belong to the same category as the one just described from Randen; it consists of the whole of the septate part of the shell, with the somewhat large open umbilicus characteristic of *N. intermedius*, and agreeing in the flattening of the periphery and the somewhat flattened sides with the Randen fossil.

A remarkably fine specimen (No. 39718) from Lyme Regis may be referred provisionally to this species; it is more inflated than the other examples, and the longitudinal ridges have a tendency to become obsolete on the sides. Its dimensions are as follows:—greatest diameter $9\frac{3}{4}$ inches, width of umbilicus $1\frac{3}{4}$ inch, width of aperture (a little distorted) 7 inches, height $4\frac{1}{4}$ inches.

Horizon. Lias.

Localities. *British.* Whitby, Yorkshire; (?) Keynsham, Somerset-

¹ Fossiles des Terrains Secondaires de la Province de Luxembourg (Extr. du tom. xxxiii. des Mém. de l'Acad. Roy. de Belgique), 1858, p. 11, pl. ii. ff. 1c, 1d.

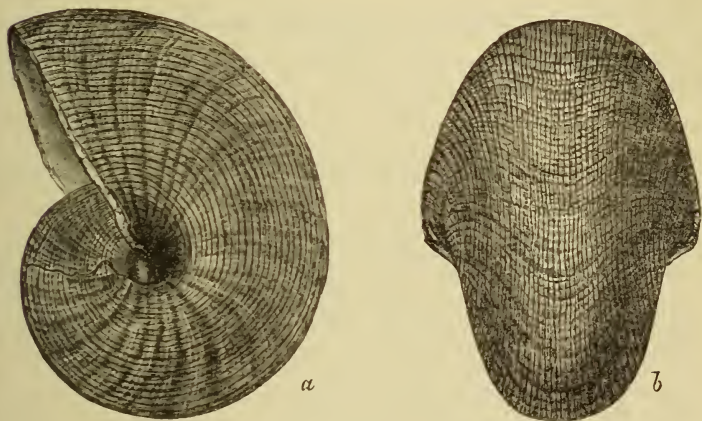
shire; Warkworth, Northamptonshire.—*Foreign.* Randen, near Schaffhausen, Switzerland; Uhrweiler, Alsace.

Well represented in the Collection. Specimens numbered C. 484, C. 2963, and C. 2964 have no localities recorded against them.

***Nautilus simillimus*, Foord and G. C. Crick.**

1890. *Nautilus simillimus*, Foord and G. C. Crick, *Ann. & Mag. Nat. Hist.* ser. 6, vol. v. p. 267, f. 1.

Fig. 34.



Nautilus simillimus.—*a*, lateral view of a young individual, showing the closed umbilicus; *b*, peripheral view. Drawn from a specimen (No. 39887) in the British Museum. Nearly two thirds natural size.

Sp. Char. "Shell somewhat compressed on the sides, narrowly rounded on the periphery, completely involute. Umbilicus closed by a shelly callus. Septa moderately distant; sutures slightly curved on the sides of the shell and forming a shallow sinus upon the periphery. Siphuncle unknown. Test ornamented with fine, close-set, subregular, wavy, longitudinal ridges, which are somewhat coarser on the sides of the shell than on the periphery; finer lines are intercalated between these, and the whole are crossed by fine and numerous lines of growth, which impart a cancellated appearance to the test, especially in young shells. In addition to the finer ornaments there are a series of obscure folds radiating from the umbilicus, and dying out upon the periphery.

Remarks. "This species resembles *Nautilus striatus*, J. Sowerby¹, in its general form and perfectly in its sculpture, but it is distinguished by its completely closed umbilicus. A large but imperfect and crushed example (No. 39850) represents the adult stage in the growth of the shell, while the young is exemplified in an exquisitely preserved specimen (No. 39887). The name *simillimus* which we have given to this species is intended to express its close resemblance to *N. striatus*." (*Foord and G. C. Crick.*)

Horizon. Lias.

Locality. Charmouth, Dorsetshire.

Well represented in the Collection.

***Nautilus Araris*, Dumortier.**

1869. *Nautilus Araris*, Dumortier, Études Paléontologiques du Bassin du Rhône, pt. iii. p. 56, pls. vi., vii.

1876. *Nautilus Araris*, Blake, in Tate and Blake's 'The Yorkshire Lias,' pt. ii. p. 312.

1884. *Nautilus Araris*, Simpson, The Fossils of the Yorkshire Lias, 2nd ed. p. 60.

Sp. Char. Shell large, discoid, compressed, widely umbilicated; composed of two or three whorls which are much higher than wide, rounded in the umbilical region with a slightly flattened periphery. Siphuncle very large, situated below the centre. Umbilicus large with slightly rounded borders, exposing the two inner whorls, the outer whorl covering them to the extent of rather more than half their width. There are from twenty-two to twenty-four septa, which are strongly curved on the sides, and bent backwards towards the umbilicus in a very remarkable way. Surface ornamented with interlacing lines, forming a network of which the longitudinal lines predominate. The shell must have attained a very great size, a specimen measuring 210 millim. in diameter consisting entirely of the septate portion, without any sign of the body-chamber.

Remarks. *Nautilus Araris* is separated from all other Liassic species by the height of the whorls, the size of the umbilicus, the peculiar curvature of the sutures, and the large size of its siphuncle. It is said by Dumortier to be characteristic of the zone of *Belemnites clavatus*. Professor Blake² records it from Robin Hood's Bay in the zone of *Ammonites armatus*.

This species is admirably represented in the Collection by several

¹ Min. Conch. vol. ii. p. 183, pl. clxxxii.

² Tate and Blake's 'The Yorkshire Lias,' 1876, pt. ii. p. 312.

specimens from the Middle Lias of France, and by a remarkably fine specimen from Lyme Regis. The latter retains the greater portion of the test, perfectly preserved. The umbilicus is not so open as that of *N. intermedius*, with which the present species has been compared; the specimen figured by Dumortier, wanting the shell in the umbilical region, has the appearance of being more open in that situation than it really is when the test is present.

Horizon. Middle Lias.

Localities. *British.* Lyme Regis, Dorsetshire.—*Foreign.* Milhau (Aveyron); Croisille, near Harcourt; Courcy¹ (Normandy). France.

***Nautilus truncatus*, J. Sowerby.**

- 1816. *Nautilus truncatus*, J. Sowerby, Min. Conch. vol. ii. p. 49, pl. cxxiii.
- 1836. *Nautilus truncatus*, Roemer, Die Versteinerungen des norddeutschen Oolithen-Gebirges, p. 178.
- 1842. *Nautilus truncatus*, d'Orbigny, Paléontologie Française (Terrains Jurassiques). vol. i. p. 153, pl. xxix.
- 1848. *Nautilus truncatus*, Lycett, Quart. Journ. Geol. Soc. vol. iv. p. 191.
- 1849. *Nautilus truncatus*, Quenstedt, Die Cephalopoden, p. 55.
- 1849. *Nautilus truncatus*, d'Orbigny, Prodrome de Paléontologie Française, vol. i. p. 245.
- 1850. *Nautilus truncatus*, Sharpe, "On the Secondary Rocks of Portugal," Quart. Journ. Geol. Soc. vol. vi. p. 163.
- 1850. *Nautilus truncatus*?, R. N. Mantell, Q. J. G. S. vol. vi. p. 316.
- 1852. *Nautilus truncatus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 160.
- 1854. *Nautilus truncatus*, Morris, Catalogue of British Fossils, 2nd ed. p. 307.
- 1857. *Nautilus truncatus*, Etheridge, Mem. Geol. Surv.: Hull, On the Country around Cheltenham, pp. 23, 34, 48.
- 1858. *Nautilus truncatus*, Buckman, Quart. Journ. Geol. Soc. vol. xiv. p. 122.
- 1858. *Nautilus truncatus*, Ooster, Catalogue des Céphalopodes Fossiles des Alpes Suisses, pt. iii. p. 7.
- 1858. *Nautilus truncatus*, Quenstedt, Der Jura, p. 72.
- 1860. *Nautilus truncatus*, Wright, Quart. Journ. Geol. Soc. vol. xvi. p. 11.
- 1871. *Nautilus truncatus*, Phillips, Geology of Oxford and the Valley of the Thames, p. 164.

¹ This is a village about three and a half miles north-east of Falaise.

1873. *Nautilus truncatus*, Collenot, Description Géologique de l'Auxois, p. 292.

1882. *Nautilus truncatus*, Etheridge, Quart. Journ. Geol. Soc. (Proceedings—Anniversary Address), vol. xxxviii. p. 171.

1889. *Nautilus truncatus*, Wilson and Crick, Geological Magazine, New Series, dec. iii. vol. vi. no. viii. p. 341.

Sp. Char. "Thick, flattened, plain, umbilicate; back flat, mouth elongated, four-angled; siphuncle nearest to the inner margin of the septum." (*Sowerby*.)

Remarks. The shell in this species is somewhat compressed on the sides, and the periphery is broadly truncated, the aperture higher than wide; the umbilicus with a very small opening¹. The surface of the test is marked only with lines of growth. The septa are approximate and slightly flexuous on the sides, nearly straight in crossing the periphery. The siphuncle is situated below the centre.

This species is most nearly allied to *N. hexagonus*, J. de C. Sowerby: but the latter is distinctly umbilicated with the sides of the umbilicus very steep, it has also wider and more flexuous septa. These two species agree, however, in having a narrow flattened periphery, and a siphuncle situated below the centre.

Besides Sowerby's original type of *N. truncatus*, there are in the Museum ('Sowerby Collection') two specimens from the Lias of Kilsby Tunnel, Northamptonshire, which are referred to that species with some doubt, owing to their imperfect condition. They are numbered 19518 *l* and 19518 *m*; they both have a larger umbilicus than Sowerby's type, and in this respect approach *N. hexagonus*.

M. Eudes-Deslongchamps, in 'Études sur les Étages Jurassiques Inférieures de la Normandie' (1864, p. 149), cites *Nautilus hexagonus* as occurring in the Great Oolite (Assises supérieurs, Calc. à polyp.) of Ranville, which is probably a mistake, as there are two specimens in the British Museum from the same locality and horizon, which are undoubtedly *N. truncatus*; and as M. Deslongchamps mentions only one species of *Nautilus* at Ranville, it is most likely to have been the last-named species.

A large specimen (registered No. 34297) from the Upper Lias of Milhau (Aveyron), France, is also referred to the present species with some hesitation, as the characters are not fully ascertainable. The shell is apparently full-grown; the test is preserved on one side of it and exhibits strong lines of growth; the deep sinus of the

¹ D'Orbigny represents it (*loc. cit.* pl. xxix.) as quite closed, but this is an error.

aperture is also seen. The umbilicus is of medium size, somewhat larger proportionally than that of Sowerby's type specimen. The periphery is very flat until near the aperture, where it becomes rounded.

It may be mentioned that Sowerby figured only a portion of his type specimen in the 'Mineral Conchology.'

N. truncatus would appear to be a somewhat rare species.

Horizon. Lias (England); Upper Lias (France).

Localities. British. Keynsham, near Bristol, Somersetshire (Sowerby's type); Northamptonshire; Rodborough, Gloucestershire.—

Foreign. Milhau (Aveyron); Ranville (Calvados), Marquise, near Boulogne. France.

Fairly well represented in the Collection, which includes Sowerby's type ("Sowerby Collection"—No. 44117 *a*), figured in the 'Mineral Conchology.'

***Nautilus astacoides*, Young and Bird.**

1828. *Nautilus astacoides*, Young and Bird, A Geological Survey of the Yorkshire Coast, p. 270, pl. xiii. f. 2.

1835. *Nautilus astacoides*, Phillips, Geol. of Yorkshire, p. 166, pl. xii. f. 16.

1837. *Nautilus astacoides*, Hunton, Trans. Geol. Soc. vol. v. p. 219.

1849. *Nautilus astacoides*, d'Orbigny, Prodrome de Paléontologie Stratigraphique, vol. i. p. 245.

1854. *Nautilus astacoides*, Morris, Catalogue of British Fossils, 2nd ed. p. 306.

? 1874. *Nautilus astacoides*, Dumortier, Études Paléontologiques sur les Dépôts Jurassiques du Bassin du Rhône, pt. iv. p. 41, pl. v. ff. 1-4 (not pl. viii. f. 4).

1876. *Nautilus astacoides*, Blake, in Tate and Blake's 'The Yorkshire Lias,' p. 313.

Sp. Char. Shell inflated, somewhat compressed at the sides and on the periphery, the whorls wider than high, the widest part a little below the middle. The umbilicus is rather large, with rounded margins. The septa, which number about twenty to a whorl, are only slightly sinuous. The siphuncle is situated a little below the centre. The shell is ornamented throughout with strong irregular longitudinal lines, crossed by transverse indistinct flexuous lines which form a sinus upon the periphery.

Remarks. The species bearing the closest resemblance to *N. astacoides* is the *N. intermedius* of Sowerby; but in the latter the siphuncle is above the centre, and the periphery is very distinctly flattened, while the umbilicus is much larger.

M. Dumortier figures (*loc. cit.* pl. viii. f. 4) a fragment from Crusol, which he incorrectly refers to *astacoides*; the sculpture and the larger size of the umbilicus show that it belongs to *N. striatus*.

Horizon. Lower Lias; Upper Lias.

Localities. Lyme Regis, Dorsetshire; Whitby, Yorkshire.

Well represented in the Collection. Two of the specimens (No. C.1380 and C.1381) were presented by J. E. Lee, Esq., F.S.A., F.G.S.

***Nautilus semistriatus*, d'Orbigny.**

- 1842. *Nautilus semistriatus*, d'Orbigny, Paléontologie Française (Terrains Jurassiques), vol. i. p. 149, pl. xxvi.
- 1845. *Nautilus semistriatus*, Murchison, Geology of the Neighbourhood of Cheltenham, new ed. p. 91.
- 1849. *Nautilus semistriatus*, Quenstedt, Die Cephalopoden, p. 56.
- 1849. *Nautilus semistriatus*, d'Orbigny, Prodrome de Paléontologie Stratigraphique, vol. i. p. 245.
- 1850. *Nautilus semistriatus*, Coquand and Bayle, Bull. Soc. Géol. de France, sér. ii. vol. vii. p. 235.
- 1852. *Nautilus semistriatus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 164.
- 1853. *Nautilus semistriatus*, Studer, Geologie der Schweiz, Band ii. p. 36.
- 1854. *Nautilus semistriatus*, Morris, Catalogue of British Fossils, 2nd ed. p. 307.
- 1858. *Nautilus semistriatus*, Oppel, Die Juraformation Englands, Frankreichs und des südwestlichen Deutschlands, p. 241.
- 1858. *Nautilus semistriatus*, Ooster, Catalogue des Céphalopodes Fossiles des Alpes Suisses, pt. iii. p. 7.
- 1868. *Nautilus semistriatus*, Reynés, Essai de Géologie et de Paléontologie Aveyronnaises, p. 69.
- 1869. *Nautilus semistriatus*, Dumortier, Études Paléontologiques sur les Dépôts Jurassiques du Bassin du Rhône, pt. iii. p. 55.
- 1871. *Nautilus semistriatus*, Phillips, Geology of Oxford and the Valley of the Thames, p. 131.
- 1882. *Nautilus semistriatus*, Etheridge, Quart. Journ. Geol. Soc. (Proceedings—Anniversary Address), vol. xxxviii. p. 171.
- 1884. *Nautilus semistriatus*, L. Mallada, Bol. Com. del Mapa Geol. de España, vol. xi. Sinopsis de Fósiles de España, p. 19. (Figured *ibid.* vol. v. 1878, pl. iii. f. 9.)
- 1888. *Nautilus semistriatus*, Beeby Thompson, The Middle Lias of Northamptonshire, p. 54.

Sp. Char. Shell much compressed, the periphery narrowly trunc-

cated, the umbilicus small, exposing the inner whorls. Aperture elongated, much higher than wide. Septa approximate, the sutures gently curved on the sides and forming a slight backwardly-directed sinus upon the periphery. Siphuncle nearly central, or very slightly above the centre. The surface of the test is smooth upon the sides of the shell, but striated longitudinally around the umbilicus and on the periphery.

Remarks. This species may be distinguished from others when the test is absent by the approximate septa and very compressed form of the shell; and when the test is preserved, the striæ developed only on the periphery and in the umbilical region separate it from *Nautilus striatus* and *N. intermedius*.

The example representing this species in the Collection agrees with d'Orbigny's description and figures except in two respects: first, the form of the umbilicus, which has steep walls and an angular border in the British Museum specimen, whereas in d'Orbigny's figure (pl. xxvi. fig. 1) the sides of the umbilicus are sloping and gently rounded; secondly, the periphery in d'Orbigny's specimen is flattened, in ours it is narrowly rounded. Our specimen is, however, only half the size of d'Orbigny's, and therefore the characters in which the two differ may be accounted for by their disparity of age. Dumortier records this species from the lowest beds of the Middle Lias; d'Orbigny from the Upper Lias, and always in association with *Ammonites bifrons*.

Horizon. Upper Lias.

Locality. Fontaine-Étoupe-Four (Calvados), France.

Represented in the Collection by a single example.

Nautilus Toarcensis, d'Orbigny.

- 1842. *Nautilus latidorsatus*, d'Orbigny, Paléontologie Française (Terrains Jurassiques), vol. i. p. 147, pl. xxiv. (*Not* of Schlotheim.)
- 1849. *Nautilus latidorsatus*, Quenstedt, Die Cephalopoden, p. 56.
- 1849. *Nautilus Toarcensis*, d'Orbigny, Prodrome de Paléontologie Stratigraphique, vol. i. p. 245.
- 1852. *Nautilus latidorsatus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 153.
- 1854. *Nautilus Toarcensis*, Millet, Paléontologie de Maine et Loire, p. 68.
- 1857. *Nautilus latidorsatus*, Lycett, The Cotteswold Hills, p. 162.
- 1858. *Nautilus Toarcensis*, Oppel, Die Juraformation Englands, Frankreichs und des südwestlichen Deutschlands, p. 241.

1858. *Nautilus latidorsatus*, Ooster, Catalogue des Céphalopodes Fossiles des Alpes Suisses, pt. iii. p. 4.
1858. *Nautilus latidorsatus*, Quenstedt, Der Jura, p. 284.
1864. *Nautilus Toarcensis*, Eudes-Deslongchamps, Études sur les Étages Jurassiques Inférieurs de la Normandie, p. 23.
1869. *Nautilus Toarcensis*, Magnan, Études des Formations secondaires des Bords S.-O. du Plateau Central de la France, p. 61.
1873. *Nautilus latidorsatus*, Sharp, Quart. Journ. Geol. Soc. vol. xxix. p. 290.
1877. *Nautilus latidorsatus*, J. Buckman, Quart. Journ. Geol. Soc. vol. xxxiii. p. 2.
1880. *Nautilus Toarcensis*, Choffat, Étude Stratigraphique et Paléontologique des Terrains Jurassiques du Portugal (Section des Travaux Géologiques du Portugal), p. 30.
1882. *Nautilus latidorsatus*, Etheridge, Quart. Journ. Geol. Soc. (Proceedings—Anniversary Address), vol. xxxviii. p. 171.
1884. *Nautilus latidorsatus*, L. Mallada, Bol. Com. del Mapa Geol. de España; Sinopsis de Fósiles de España, vol. xi. p. 19. (Figured *ibid.* vol. v. 1878, pl. iii. ff. 1, 2.)

Sp. Char. Shell much inflated, of a quadrate form, somewhat flattened at the sides above the middle, and expanding just above the umbilicus, broadly truncated on the periphery; umbilicus of moderate size, with steeply sloping sides. Aperture wider than high. Septa approximate, very slightly sinuous on the sides and periphery. Test smooth.

Remarks. This species is most nearly related to *N. inornatus*, but the septa are much less flexuous, the whorls proportionately wider transversely, and the aperture more quadrate.

N. Toarcensis is represented in the Collection by a specimen which is unfortunately without a locality, but it is probably of Continental origin; most likely from France.

Horizon. Upper Lias.

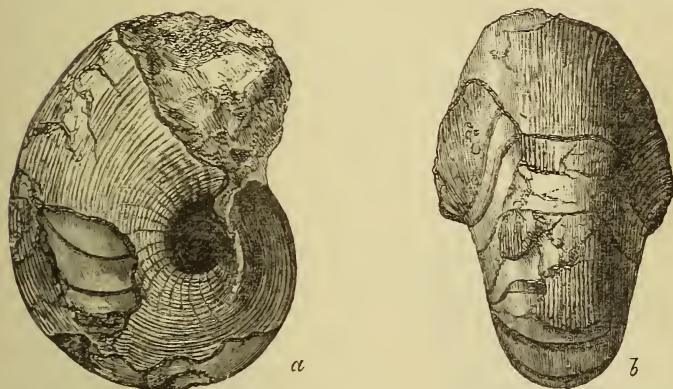
Locality. Unknown.

***Nautilus Jourdani*, Dumortier.**

1874. *Nautilus Jourdani*, Dumortier, Études Paléontologiques sur les Dépôts Jurassiques du Bassin du Rhône, pt. iv. (Lias Supérieur), p. 44, pl. vii. ff. 1 5.
1889. *Nautilus Jourdani*, S. S. Buckman, Quart. Journ. Geol. Soc. vol. xlv. p. 453 (footnote).
1890. *Nautilus Jourdani*, Foord and G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 268, f. 2.

Sp. Char. "Shell moderately inflated, umbilicus not very large, whorls flattened both on the sides and on the periphery, the greatest thickness being at the umbilicus. The sides of the latter are steep and the borders subangular, the test being here very thick. The septa, of which there are about thirteen in an entire whorl, form a strongly marked sigmoidal curve upon the sides of the shell, but are

Fig. 35.



Nautilus Jourdani.—*a*, lateral view, showing the deep umbilicus and the ornaments of the test; *b*, peripheral view, showing the form of the sutures. Drawn from a specimen in the British Museum (No. 19587). About one half natural size.

only very slightly sinuous on the periphery. The siphuncle is situated a little below the centre. The test is covered with numerous, thread-like, longitudinal ridges, two or three in the space of 1 line, more approximate on the periphery than on the sides, as is usually the case with such ornaments. The ridges become partly obsolete when the shell has attained a certain diameter, say between 4 and 5 inches. Fine lines of growth are seen where the shell is well preserved, especially in the region of the umbilicus.

"It should be added that the interior of the umbilicus is ornamented with fine, radiating, flexuous ridges directed forwards; these are crossed by spiral ridges somewhat widely spaced.

Remarks. "This species is distinguished from *N. ornatus* (to be subsequently described), which appears to be its nearest ally, by its

more compressed form, more angular umbilicus, and finer sculpture." (*Foord and G. C. Crick.*)

Horizon. Upper Lias.

Locality. Floore, Northamptonshire.

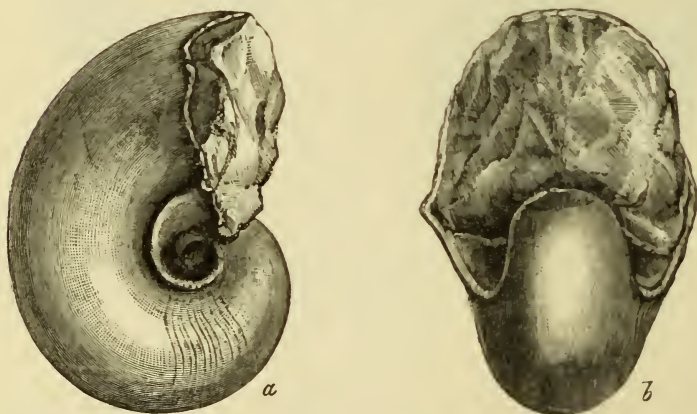
Represented in the Collection by a single example.

***Nautilus terebratus*, Dumortier.**

1874. *Nautilus terebratus* (Thiollière), Dumortier, *Études Paléontologiques sur les Dépôts Jurassiques du Bassin du Rhône*, pt. iv. (Lias Supérieur), p. 42, pl. vi. ff. 1-4.

1890. *Nautilus terebratus*, Foord and G. C. Crick, *Ann. & Mag. Nat. Hist.* ser. 6, vol. v. p. 269, f. 3, and woodcut, f. 4.

Fig. 36.



Nautilus terebratus.—*a*, lateral view, showing the raised border of the umbilicus; *b*, front view. Drawn from a specimen in the British Museum (No. C. 3096). Two thirds natural size. Except in well-preserved specimens the longitudinal ornaments are barely visible; we have therefore given a separate figure of them (fig. 37).

Sp. Char. "Shell inflated, subglobose, a little compressed on the sides, and slightly flattened upon the periphery, more so in the adult than in the young shell. Aperture wider than high. Umbilicus open, exposing the inner whorls, very deep, the sides steep and having an angular border with a thickened rim, which is very characteristic. Septa rather distant, being nearly 1 inch apart on the periphery, where the height of the whorl is 2 inches in the specimen

measured. Sutures very slightly bent upon the sides of the shell and forming a very shallow sinus upon the periphery. Siphuncle nearly central. Test rather thin, ornamented on the periphery with fine, close-set, longitudinal ridges, crossed by lines of growth, the latter covering the whole of the surface of the test. The accompanying woodcut (fig. 37) exhibits these ornaments drawn natural size, from a specimen in the British Museum Collection.

Fig. 37.



Remarks. "The name *terebratus* was attached by Thiollière to a specimen in the museum at Lyons, and the species was subsequently described by Dumortier (*loc. cit.*), whose figures and descriptions enabled one of us to recognize it in the Woodwardian Museum, Cambridge, where it is well represented. The authorities of that Museum having kindly presented a specimen to the British Museum, we are enabled to give figures of this well characterized species, which is now recorded in Britain for the first time.

"This species has two characters in common with *Nautilus Jordanii*, Dumortier, viz. an angular umbilicus and longitudinal ornaments; but the latter are confined to the peripheral region, and the umbilicus has a very characteristic rim.

"M. Dumortier states that he only knows this species from La Verpillière¹, where it is not very rare; but entire specimens are uncommon. He adds that it is one of the most characteristic shells of the Upper Lias of France." (*Foord and G. C. Crick.*)

Horizon. Upper Lias.

Locality. Near Lincoln.

Represented in the Collection by a single example.

***Nautilus robustus*, Foord and G. C. Crick.**

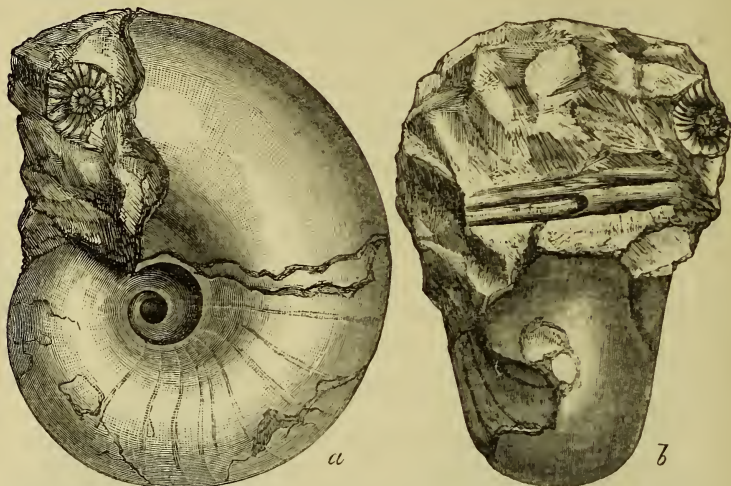
1890. *Nautilus robustus*, Foord and G. C. Crick, Ann. & Mag. Nat. Hist., ser. 6, vol. v. p. 271, f. 5.

Sp. Char. "Shell of robust habit, slightly compressed on the sides and flattened on the periphery, especially towards the aperture; the angles formed by the junction of the sides and periphery rounded. Umbilicus open and exposing almost all the inner whorls; its sides rounded and rather steeply sloping. Aperture wider than high. Septa 1 inch distant from each other in the

¹ A village in the Department of Isère, about 18 miles north-east of Vienne.

median line of the periphery, where the whorl has a thickness of $3\frac{1}{2}$ inches; in the middle of the sides their distance is only half an

Fig. 38.



Nautilus robustus.—*a*, lateral view, showing the cast of part of the body-chamber, the test being present in the septate part of the shell, where a few lines of growth are indicated; *b*, front view. Drawn from a specimen in the British Museum (No. 37010). Rather less than one third natural size.

inch; the last two septa are only three quarters of an inch apart on the periphery. The siphuncle has not been seen. The body-chamber occupies at least one half of the last whorl. The test is very thick and its surface smooth, or marked only with lines of growth, as seen on fig. 38, *a*.

Remarks. "There are three examples of this fine species in the British Museum Collection, two of which are adult shells and the other in the adolescent stage of growth. The largest specimen (the figured one) measures about 8 inches in its greatest diameter and about $5\frac{1}{2}$ inches in its greatest width.

"This species is most nearly allied to *Nautilus Toarcensis*, d'Orbigny¹, but is distinguished by its narrower form, more open umbilicus, and closer septa.

"Not feeling certain that the present species had not already been

¹ Prodr. de Paléont. Stratigr. vol. i. p. 245, = *N. latidorsatus*, d'Orb. Pal. Franç., Terr. Jurass. vol. i. p. 147, pl. xxiv. (not of Schlotheim).

described, we communicated with Dr. Paul Fischer, of the Museum of Natural History, Paris, enclosing woodcuts of this and of another species described in the present paper under the name of *N. Fischeranus*. Dr. Fischer has kindly replied to the effect that he finds no form either in the Museum of Natural History, the Museum of the École des Mines, nor in that of the Sorbonne, which can be identified with certainty with either of our specimens. With regard to the form here called *N. robustus*, he observes that it resembles perhaps some specimens of *Nautilus Tauricensis*, d'Orb., but that the umbilicus in the latter appears more open and the aperture more dilated. With these remarks we fully concur, and we are glad to have the opinion of so experienced a palæontologist as Dr. Fischer in confirmation of our own." (*Foord and G. C. Crick.*)

Horizon. Upper Lias.

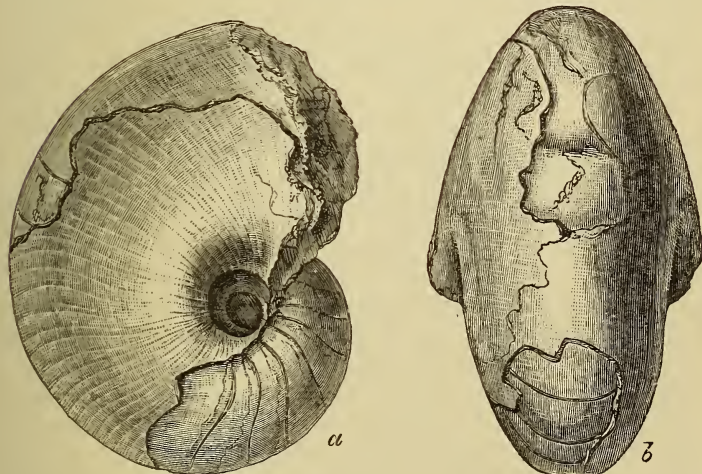
Localities. Moutiers, Courcy (Calvados), France.

Well represented in the Collection.

Nautilus Fischeranus, Foord and G. C. Crick.

1890. *Nautilus Fischeranus*, Foord and G. C. Crick, *Ann. & Mag. Nat. Hist.* ser. 6, vol. v. p. 272, f. 6.

Fig. 39.



Nautilus Fischeranus.—*a*, lateral view, showing the test with fine lines of growth and some of the sutures, where the shell is removed; *b*, peripheral view. Drawn from a specimen in the British Museum (No. 37007). Rather more than one third natural size.

Sp. Char. "Shell compressed, with deeply embracing whorls, rapidly increasing in diameter; flattened upon the sides, with a narrowly rounded periphery. Umbilicus deep, with rather steeply sloping sides, the inner whorls exposed. Septa somewhat distant from each other, being about three quarters of an inch apart in the median line of the periphery, where the thickness of the whorl is 2 inches. Sutures slightly curved upon the sides and forming a very shallow sinus upon the periphery. Test smooth, showing only irregular lines of growth. Only a part of the body-chamber is preserved, so that the proportion it bears to the septate part of the shell cannot be ascertained.

Remarks. "The present form is so unlike any other fossil *Nautilus*, that no comparison can be made.

"A figure of the present species was submitted to Dr. Paul Fischer (along with one of *N. robustus*), and he fails to identify it with any species known to him, but suggests the possibility of its being represented in the private collection of the late Eugène Eudes-Deslongchamps at Caen. However this may be, we, like Dr. Fischer, can find no published description or figure which can be identified with it.

"We have much pleasure in dedicating this beautiful species to Dr. Paul Fischer, of Paris, who has laid us under many obligations in connexion with the Jurassic Nautili." (*Foord and G. C. Crick.*)

Horizon. Upper Lias.

Locality. Fontaine-Étoupe-Four (Calvados), France.

Represented in the Collection by a single example.

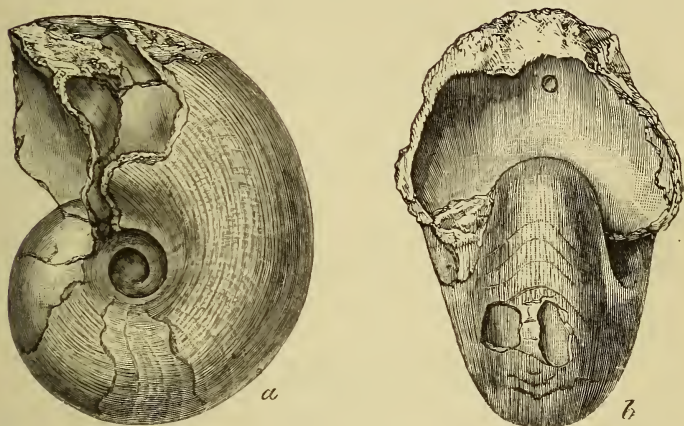
***Nautilus ornatus*, Foord and G. C. Crick.**

1890. *Nautilus ornatus*, Foord and G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 273, f. 7.

Sp. Char. "Shell inflated, rapidly enlarging; sides compressed, but somewhat inflated in the middle; periphery broad, flattened. Umbilicus of moderate size and exposing a portion of the inner whorls; sides steep, margin rounded. Septa rather distant, being $2\frac{1}{2}$ inches apart where the whorl has a height of about 6 inches. Siphuncle rather large, situated above the centre. The test is ornamented in the adult shell with a series of longitudinal flattened bands separated by incised lines; these bands are almost entirely confined to the periphery, very few of them extending to the sides of the shell; they number about thirteen to an inch. The whole of the test is covered with fine subregular lines of growth, which

curve backwards on approaching the periphery, where they form a shallow sinus. In a young shell ($4\frac{1}{4}$ inches in diameter, see fig. 40) the longitudinal ornaments cover the whole surface of the test, and

Fig. 40.



Nautilus ornatus.—*a*, lateral view of a young shell, showing the open umbilicus and the ornamentation of the test; *b*, front view, showing the position of the siphuncle. Drawn from a specimen in the British Museum (No. 51952). About half natural size.

they are in the form of delicate irregularly-spaced ridges, with very fine lines occupying the interspaces. The ridges are more numerous on the periphery than on the sides of the shell.

Remarks. "The adult characters of the ornamentation of this species have been drawn up from a gigantic specimen, 2 feet in diameter, which was found at Sherborne, Dorsetshire. This is probably one of the largest examples of *Nautilus* known; at least the writers have never seen any account of a specimen approaching it in size. A smaller one from the same locality (Sherborne) measures 11 inches in its greatest diameter; it is a cast of the septate part of the shell, together with a portion of the body-chamber. Fragments of the test with its characteristic ornaments adhere to the cast in one or two places.

"This species, in respect to its ornamentation, bears some resemblance to *N. Jourdani* of the Upper Lias, but can be at once distinguished by its less angular whorls and the rounded margin of the umbilicus. The latter character also distinguishes it from *N. terebratus* from the same beds, whose ornaments, like those of the adult shell of *N. ornatus*, are almost entirely confined to the peripheral

area. There are no other species known to us from the Inferior Oolite with which this form can be confounded." (*Foord and G. C. Crick.*)

The large specimen mentioned above has lately been added to the Collection (No. C. 3193). Its weight—182 lbs.—may give a better idea of its size than the linear measurement.

Horizon. Inferior Oolite.

Localities. Near Sherborne, Burton Bradstock, Dorsetshire; Minchinhampton Common, Gloucestershire; Dundry, Somersetshire; Bradford, Wiltshire.

The localities of three of the specimens (numbered 51952 (the type), C. 127, and C. 1580) are not known, but they are almost certainly in England.

Remarkably well represented in the Collection. The specimen numbered C. 1580 was presented by J. E. Lee, Esq., F.S.A., F.G.S.

***Nautilus lineatus*, J. Sowerby.**

- 1813. *Nautilus lineatus*, J. Sowerby, Min. Conch. vol. i. p. 89, pl. xli.
- ‡ 1820. *Nautilites aperturatus*, Schlotheim, Die Petrefactenkunde, p. 82.
- 1821. *Nautilus lineatus*, Winch, Trans. Geol. Soc. vol. v. pt. ii. p. 555.
- 1830. *Nautilites lineatus* (?), Zieten, Les Pétrifications de Wurtemberg, p. 23, tab. xviii. figs. 2 a-c.
- 1832. *Nautilus lineatus*, Lonsdale, Trans. Geol. Soc. ser. 2, vol. iii. pt. ii. p. 272.
- 1835. *Nautilus lineatus*, Phillips, Geol. of Yorkshire, pt. i. p. 129.
- 1836. *Nautilus lineatus*, Roemer, Die Verstein. des norddeutschen Oolithen-Gebirges, p. 179.
- 1840. *Nautilus lineatus*, Millet, Bull. Soc. Géol. de France, vol. xi. p. 365.
- 1845. *Nautilus lineatus*, Murchison, Outline of the Geology of the Neighbourhood of Cheltenham, new ed. p. 80.
- 1849. *Nautilus lineatus*, Quenstedt, Die Cephalopoden, p. 56, tab. ii. fig. 16.
- 1850. *Nautilus lineatus*, Lycett, Ann. & Mag. Nat. Hist. ser. 2, vol. ii. p. 412.
- 1852. *Nautilus lineatus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 154.
- 1854. *Nautilus lineatus*, Morris, Cat. British Fossils, 2nd ed. p. 307.
- 1857. *Nautilus lineatus*, Etheridge, in Mem. Geol. Surv. Great Britain: Hull, on the Geology of the Country around Cheltenham, pp. 42, 48.
- 1858. *Nautilus lineatus*, Ooster, Cat. des Céphalopodes Fossiles des Alpes Suisses, pt. iii. p. 8.
- 1858. *Nautilus lineatus*, Quenstedt, Der Jura, p. 284.

1853. *Nautilus lineatus*, Oppel, Die Juraformation Englands, Frankreichs und des südwestlichen Deutschlands, p. 366.
1860. *Nautilus lineatus*, Wright, Quart. Journ. Geol. Soc. vol. xvi. p. 40.
1860. *Nautilus lineatus*, Coquand, Synop. des Foss. Second. de la Charente, de la Charente-Inférieure, et de la Dordogne, p. 9.
1864. *Nautilus lineatus*, Ebray, Études Géologiques sur le Département de la Nièvre, fasc. 13, 14, p. 269.
1867. *Nautilus lineatus*, Waagen, Ueber die Zone des *Ammonites Sowerbyi* (Geogn. Paläont. Beiträge, Band i.) p. 590 (84).
1871. *Nautilus lineatus*, Phillips, Geology of Oxford and the Valley of the Thames, pp. 131, 164.
1875. *Nautilus lineatus*, Lepsius, Beiträge zur Kenntn. der Juraformation im Unter-Elsass, p. 26.
1879. *Nautilus lineatus*, Stoddart, Proceed. Bristol Naturalists' Soc vol. ii. pt. iii. p. 279.
1880. *Nautilus lineatus*, Choffat, Étude Stratigraphique et Paléontologique des Terrains Jurassiques du Portugal, livr. i. p. 41.
1884. *Nautilus lineatus*, Mallada, Boletín de la Comisión del Mapa Geológico de España, Sinopsis de las Especies Fósiles de España, vol. xi. p. 228. (Figured *ibid.* vol. v. 1878, pl. iv. ff. 5, 6.)
1884. *Nautilus lineatus*, Damon, Geology of Weymouth, Portland, and Coast of Dorsetshire, new ed. p. 220.
1890. *Nautilus lineatus*, Foord and G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 274, f. 8.
- [Not 1842. *Nautilus lineatus*, d'Orbigny, Paléont. Franç., Terr. Jurass. vol. i. p. 155, pl. xxxi.]

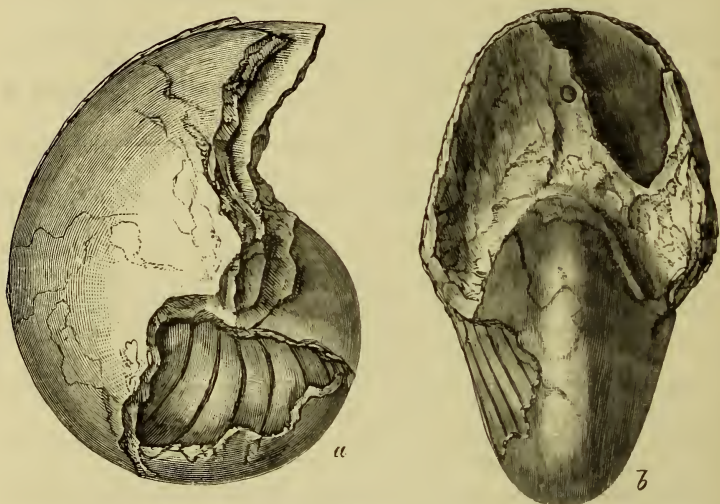
Sp. Char. “ ‘ Flatted, spheroidal, umbilicate, surface obscurely striated, back flat, broad, with a concave line in the interior (which appears convex around the cast). Aperture rather square, deeply indented by the preceding whorl; septa numerous. . . . Diameter about one third longer than the thickness. The septa are very concave, with three slight waves in their margins. The siphunculus is near the middle of each septa ’ [septum]. (*Sowerby*.)

Remarks. “ The unsatisfactory character of *Sowerby*’s description and figures of this species has given rise to much confusion regarding its identity, and more than one species has doubtless been included under the name *lineatus*.

“ Though neither of the figured types of *lineatus* are contained in the British-Museum Collections, yet there is a specimen (one of those (a cast) numbered 43854) labelled in *Sowerby*’s handwriting ‘*Nautilus lineatus*, M. C. 41,’ which agrees in all respects with his figures in the ‘*Mineral Conchology*’ (vol. i. pl. xli.). He, however, describes the species as ‘umbilicate,’ a statement which is not borne out by his figures; and we think it highly probable that *Sowerby*’s

figured specimens (which are both casts) had a closed umbilicus, because if the shell were present it would entirely fill up the cavity seen in the cast. Another specimen (cut and polished and also numbered 43854) is also labelled by Sowerby "*Nautilus lineatus*,

Fig. 41.



Nautilus lineatus. — *a*, lateral view, showing the closed umbilicus, and parts of the septa where the test is broken away; *b*, front view, showing the position of the siphuncle and the compressed form of the shell. Drawn from a specimen in the British Museum (No. 43854 *a*), "Sowerby Collection." A little less than one half natural size.

M. C." but it differs from his figured types in more than one particular, viz. in its more flexuous and less numerous septa, and in the siphuncle, which, instead of being near the centre, as in the type (lower figure of Sowerby's plate), is above. To this form we have therefore given a new name—*Nautilus pseudolineatus*.

"*Nautilus lineatus* must now be restricted to shells of a somewhat robust habit of growth, with flattened sides and broad flattened periphery, closed umbilicus, numerous, very slightly flexuous septa, and a nearly central siphuncle. It may be added that the shell had a perfectly smooth surface.

"The name *lineatus*, which was clearly intended by its author to have reference to the faint ridge seen upon casts along the median line of the periphery, has apparently misled many palæontologists, for we have seen in collections various Jurassic Nautili labelled '*lineatus*' which certainly belonged to more than one species. In

point of fact, this median line or ridge is the 'Normallinie' of the Brothers Sandberger¹, and cannot be used as a specific character, since it is found not only in numerous species of the Nautilidæ, but also in some species of the Orthoceratidæ.

"The following species are evidently closely related, viz.:—*Nautilus lineatus*, *N. pseudolineatus*, sp. nov., *N. polygonalis*², and *N. glaber*, sp. nov." (Foord and G. C. Crick.)

Horizon. Inferior Oolite.

Locality. Yeovil, Somersetshire. The specimen already referred to as bearing one of Sowerby's labels ("*Nautilus lineatus*, M. C. 41") is not localized.

Well represented in the Collection.

***Nautilus pseudolineatus*, Foord and G. C. Crick.**

1890. *Nautilus*, sp. nov., Foord and G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 222, f. 3.

1890. *Nautilus pseudolineatus*, Foord and G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 277, f. 9.

Sp. Char. "Shell subcompressed, flattened upon the sides and periphery, the latter being moderately broad and having a sub-angular border. Umbilicus closed. Whorls about three, increasing rather slowly in diameter. Body-chamber occupying about half a volution; aperture wider than high. Septa rather deeply concave, nineteen or twenty in the last whorl, the last two very approximate. Sutures forming a sigmoid curve on the sides of the shell and a slight sinus on the periphery. Siphuncle rather large, subcentral. Test thick, smooth. Anterior border of muscular impression well defined, broadly arched (see fig. 42).

Remarks. "The greatest diameter of the largest specimen in the Collection (No. C. 324) is $6\frac{1}{4}$ inches.

"The slow rate of increase of the whorls in this species is its distinguishing character. It is nearly allied to *N. lineatus*, Sow., but differs therefrom in its more distant and flexuous sutures, more concave septa, the position of its siphuncle, and its slower rate of increase." (Foord and G. C. Crick.)

Horizon. Inferior Oolite.

Localities. Sherborne, Bridport, Burton-Bradstock, Dorsetshire; Yeovil, Somersetshire. A fine specimen—a section (No. C. 324 b)—

¹ 'Die Versteinerungen des rheinischen Schichtensystems in Nassau,' G. and F. Sandberger, 1850-56, p. 41.

² J. de C. Sowerby, Min. Conch. vol. vi. p. 56, pl. dxxx.

is also recorded from Somersetshire, but from what place in that county is not known. Two specimens, numbered respectively 43854

Fig. 42.

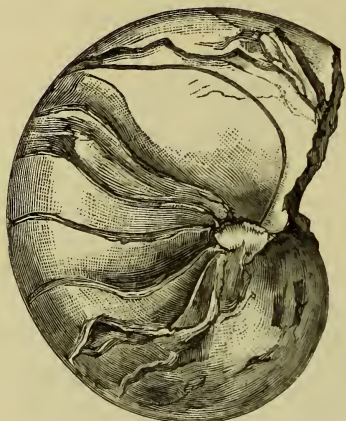


Fig. 43.



Fig. 42. *Nautilus pseudolincatus*.—Lateral view of a specimen, showing the closed umbilicus and several of the septa; the anterior border of the impression of the shell-muscle is seen on the body-chamber. Drawn from a specimen in the British Museum (No. 69767). One third natural size.

Fig. 43. *Nautilus polygonalis*.—Lateral view of a specimen, showing the closed umbilicus and several of the much-curved sutures. The anterior border of the impression of the shell-muscle is seen in a similar position to that which it occupies in fig. 42. Drawn from a specimen in the British Museum (No. C. 2847). One third natural size.

("Sowerby Coll.") and C. 2942, have no locality recorded against them in the register.

Well represented in the Collection.

***Nautilus polygonalis*, J. de C. Sowerby.**

[See Fig. 43, *suprà*.]

1826. *Nautilus polygonalis*, J. de C. Sowerby, Min. Conch. vol. vi. p. 56, pl. dxxx.

1852. *Nautilus polygonalis*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 147.

1854. *Nautilus polygonalis*, Morris, Catalogue of British Fossils, 2nd ed. p. 307.

1873. *Nautilus polygonalis*, Sharp, Quart. Journ. Geol. Soc. vol. xxix. pp. 294, 299.

1890. *Nautilus polygonalis*, Foord and G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 222, f. 4.

Sp. Char. "Sphæroidal, compressed, smooth; columella prominent; umbilicus very small; aperture arcuate, above half the diameter of the shell, long; septa distant; siphuncle near the outer edge of the septum, composed of a number of straight tubes. The thickness of this is about two thirds of its diameter; it has a large aperture, the reflected extremities of which nearly close the umbilicus; the septa are distant, very concave, and but slightly curved at their edges; the siphuncle consists of a number of straight tubes, each projecting a little behind the septum it pierces to join the preceding tube. The whole series appears to be disjointed; the polygon formed by it in the section has suggested the specific name." (*Sowerby*.)

Remarks. This species is distinguished from *N. lineatus*, which it closely resembles, by its less numerous septa, with their strongly sinuous sutures, and by the position of the siphuncle.

The impression of the shell-muscle is well shown in one of the specimens in the Collection (No. C. 2847), and is indicated in fig. 43. It is very similar both in form and position to that of the recent *Nautilus*.

Horizon. Inferior Oolite.

Locality. Halfway House, Dorsetshire; Dundry, Somersetshire. *Sowerby* states that his specimen is "probably from Dorsetshire." The localities of other specimens in the Collection are not known, but they are undoubtedly British.

Well represented in the Collection, which contains ("Sowerby Collection") J. de C. *Sowerby's* figured type.

***Nautilus glaber*, Foord and G. C. Crick.**

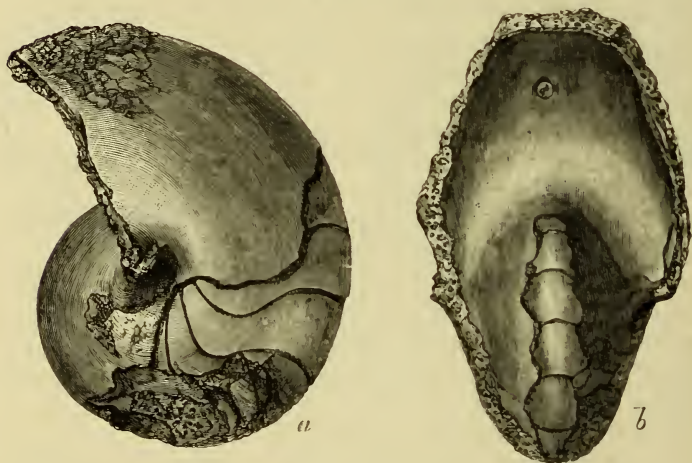
1890. *Nautilus glaber*, Foord and G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 278, f. 10.

Sp. Char. "Shell completely involute, slowly increasing in diameter, compressed laterally, flattened on the periphery. Whorls wider than high, widest just above the umbilical region. Umbilicus completely closed. Septa moderately distant, shallowly concave; the sutures strongly bent backwards on the sides and very slightly sinuated upon the periphery. Siphuncle situated markedly above the centre. Surface of the test quite smooth. Body-chamber

unknown. The larger specimen of the two representing this species in the British Museum Collection measures about $5\frac{1}{2}$ inches in its greatest diameter.

“*Remarks.* This species is nearly related to *N. pseudolineatus*, but differs therefrom in its compressed form, more distant septa, and strongly bent sutures, as well as in the more nearly marginal

Fig. 44.



Nautilus glaber.—*a*, lateral view, showing the closed umbilicus and some of the septa exposed by the removal of part of the test; *b*, front view, showing the position of the siphuncle and parts of the sutures, where the test is broken. Drawn from a specimen in the British Museum (No. C. 2840). Rather less than half natural size.

position of the siphuncle. It has also somewhat close affinities with *N. polygonalis*, J. de C. Sowerby¹, especially in the curved form its sutures and the position of its siphuncle. It may be distinguished from that species by its more compressed form, closer septa, and the siphuncle being further removed from the margin.” (*Foord and G. C. Crick.*)

Localities. *British.* Somersetshire.—*Foreign.* Bayeux (Calvados), France.

Well represented in the Collection.

¹ Min. Conch. vol. vi. p. 56, pl. dxxx.

***Nautilus obesus*, J. Sowerby.**

1816. *Nautilus obesus*, J. Sowerby, Min. Conch. vol. ii. p. 51, pl. cxxiv.
 1832. *Nautilus obesus*, Lonsdale, Trans. Geol. Soc. ser. ii. vol. iii. p. 273.
 1834. *Nautilus obesus*, Robert, Bull. Soc. Géol. de France, vol. iv. p. 312.
 1842. *Nautilus lineatus*, d'Orbigny, Paléontologie Française, Terr. Jurass. vol. i. p. 155, pl. xxxi. (not of J. Sowerby).
 1845. *Nautilus obesus*, Murchison, Outline of the Geology of the Neighbourhood of Cheltenham, new ed. p. 80.
 1852. *Nautilus obesus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 165.
 1854. *Nautilus obesus*, Morris, Cat. British Fossils, 2nd ed. p. 307.
 1857. *Nautilus obesus*, Etheridge, in Mem. Geol. Surv. Great Britain: Hull, On the Geology of the Country around Cheltenham, p. 48.
 1860. *Nautilus obesus*, Wright, Quart. Journ. Geol. Soc. vol. xvi. p. 40.
 1871. *Nautilus obesus*, Phillips, Geology of Oxford and the Valley of the Thames, p. 164.
 1873. *Nautilus obesus*, Sharp, Quart. Journ. Geol. Soc. vol. xxix. pp. 294, 299.
 1879. *Nautilus obesus*, Stoddart, Proceed. Bristol Naturalists' Soc. vol. ii. pt. iii. p. 279.
 1888. *Nautilus obesus*, Beeby Thompson, The Middle Lias of Northamptonshire, p. 54.
 1890. *Nautilus obesus*?, Foord and G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 223, f. 5.
 1890. *Nautilus obesus*, Foord and G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 279, f. 11.

Sp. Char. “ ‘Gibbose, umbilicate, plain; back broad, flat; mouth large, squarish; septa very numerous, not recurved; siphuncle nearly central. . . . Thickness about three fourths the diameter. The mouth is large, being two thirds the diameter long. The septa are very numerous; their angles not being recurved gives a very open form to the umbilicus. The siphuncle is transversely oval.’ (Sowerby.)

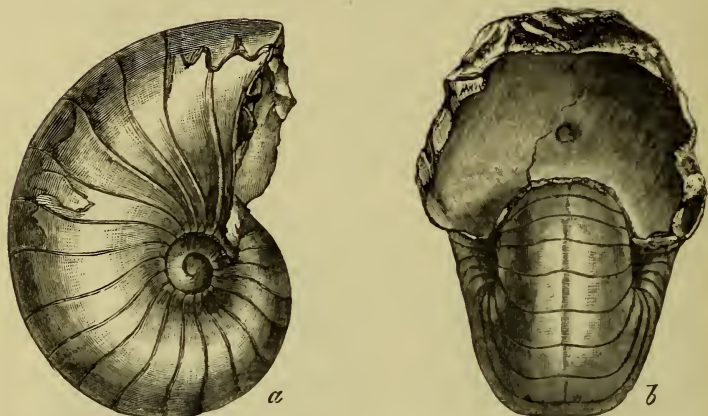
Remarks. “We may add to this description that there is a specimen in the Woodwardian Museum from Bridport, Dorsetshire, on which the test remains; it is marked only with lines of growth. This shell is 4 inches in diameter.

“This species appears to be most nearly allied to *Nautilus Toarcensis*, d'Orbigny, but the latter is readily distinguished by its much thicker and broader shell, larger umbilicus, and more distant septa.

“It is often a matter of very great difficulty to identify the species

of *Nautilus* figured in the 'Mineral Conchology,' owing partly to the brief descriptions and partly to the figures being foreshortened, with the object of economizing space by showing as much of the

Fig. 45.



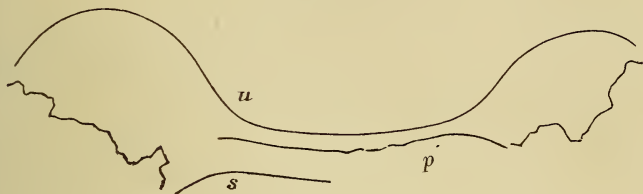
Nautilus obesus.—*a*, lateral view of a cast, showing the septa and the open umbilicus; *b*, front view, showing the position of the siphuncle. Drawn from a specimen in the British Museum (No. 39623). Rather more than one third natural size.

specimens as possible in one view. Two views at least of each species are essential in order to give a correct idea of the form of the shell. There can be little doubt, however, that the specimens we have, after very careful comparison, referred to *N. obesus* are identical with Sowerby's fossil. Though the *type* specimen is unfortunately not in the 'Sowerby Collection,' there is an example in that collection labelled, probably by Sowerby himself, '*N. obesus*,' which sufficiently agrees with the figure and description in the Min. Conch. to justify its reference thereto. Besides this individual there are several others both from England and France which, though young shells, possess unmistakably the characters of the present species. It is hoped that the figures here given of *N. obesus* may help to make it recognizable. A small badly preserved specimen (No. 20924) from the Fuller's Earth of Litchborough, Northamptonshire, most probably belongs to the present species.

"The only example of *N. obesus* known to us which shows any trace of the muscular impression is a cast of a large, crushed, and much broken body-chamber from the Ironstone (Inferior Oolite) of Duston, Northamptonshire (No. 82328 *b*). This measures 14 inches

along the curve of the periphery, the last-formed septum being $4\frac{3}{4}$ inches wide, and the width of the aperture $9\frac{1}{2}$ inches. Fig. 46 has

Fig. 46.



been reduced with the camera from a tracing of the actual impression: *a* indicates the anterior and *p* the posterior boundary; *s* indicates a portion of the last-formed septum. The irregular line on either side of the figure represents merely the broken edge of the umbilicus. Although the specimen is so badly preserved, not only can the anterior boundary of the muscular impressions and annulus be made out, but a portion also of the posterior boundary. On one side of the body-chamber several lines close to and concentric with the anterior boundary of the impression indicate former points of attachment of the anterior edge of the shell-muscle, and may be compared with similar lines to be observed in the shell of the recent *Nautilus*¹.

“On comparing examples of this species from the Inferior Oolite of Courcy, Normandy, with d’Orbigny’s figure of *Nautilus lineatus*², we find that they agree remarkably well, and we have therefore placed the *N. lineatus* of d’Orbigny in the synonymy of the present species.” (Foord and G. C. Crick.)

Horizon. Interior Oolite.

Localities. British. Duston, Litchborough, Northamptonshire; Bath, Dundry, Somersetshire; Minchinhampton, Gloucestershire.—*Foreign.* Courcy, Normandy; Aalen, Wurtemberg.

Well represented in the Collection.

***Nautilus inornatus*, d’Orbigny.**

1842. *Nautilus inornatus*, d’Orbigny, Paléontologie Française, Terr. Jurass. vol. i. p. 152, pl. xxviii.

1845. *Nautilus inornatus*, Murchison, Outline of the Geology of the Neighbourhood of Cheltenham, new ed. p. 91.

1849. *Nautilus inornatus*, d’Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 245.

¹ See Fig. 32, *a*, ante, p. 179.

² Paléont. Franç., Terr. Jurass. vol. i. p. 155, pl. xxxi. figs. 1, 2.

1857. *Nautilus inornatus*, Etheridge, in Mem. Geol. Surv. Great Britain: Hull, On the Country around Cheltenham, p. 27.
1858. *Nautilus inornatus*, Ooster, Cat. des Céphalopodes Fossiles des Alpes Suisses, pt. iii. p. 8.
1863. *Nautilus inornatus*, Day, Quart. Journ. Geol. Soc. vol. xix. p. 291.
1864. *Nautilus inornatus*, Eudes-Deslongchamps, Études sur les Étages Jurassiques Inférieurs de la Normandie, p. 83.
1871. *Nautilus inornatus*, Phillips, Geology of Oxford and the Valley of the Thames, pp. 131, 164.
- ? 1877. *Nautilus inornatus*, J. Buckman, Quart. Journ. Geol. Soc. vol. xxxiii. p. 2.
1879. *Nautilus* cf. *inornatus*, d'Orb., Branco, Der Untere Dogger Deutsch-Lothringens (Abh. zur geol. Spezialkarte von Elsass-Lothringen), Band ii. Heft i. p. 57.
1884. *Nautilus inornatus*, Mallada, Bol. Com. del Mapa Geol. de España, Sinopsis de Fósiles de España, vol. xi. p. 228. (Figured ibid. vol. v. 1878, pl. iii. ff. 5, 6.)
1890. *Nautilus inornatus*, Foord and G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 282, f. 12.

Fig. 47.



Nautilus inornatus.—*a*, lateral view of a cast, showing the septa and very small umbilicus; *b*, front view, showing the siphuncle, "normal line," and septa. Drawn from a specimen in the British Museum (No. C. 2843). Rather less than one half natural size.

Sp. Char. "Shell inflated, smooth, slightly umbilicated, flattened on the sides and periphery, making the section subquadrate, the greatest thickness being just above the umbilicus. Aperture wider than high. Sutures rather flexuous on the sides and curved backwards in crossing the periphery. There is a small dorsal (internal)

lobe. Siphuncle a little above the centre. Body-chamber unknown.

Remarks. "This species most nearly resembles *Nautilus obesus*, J. Sowerby, but it may be readily distinguished by its less robust shell, wider septa, and less open umbilicus, as well as by the slightly different position of the siphuncle.

"The French specimen is a natural cast showing the sutures, siphuncle, and internal lobe, but the ornamentation of the inner whorl or young shell only is preserved. This consists of very fine lines of growth, crossed by fine, longitudinal, thread-like lines, the decussating sculpture characteristic of the young of *Nautilus*.

"It is very doubtful whether the English references to this species are correct, because d'Orbigny's figure in the 'Paléontologie Française' does not correctly represent this species, a specimen of which from the d'Orbigny Collection we have had the opportunity of examining." (*Foord and G. C. Crick.*)

Horizon. Inferior Oolite.

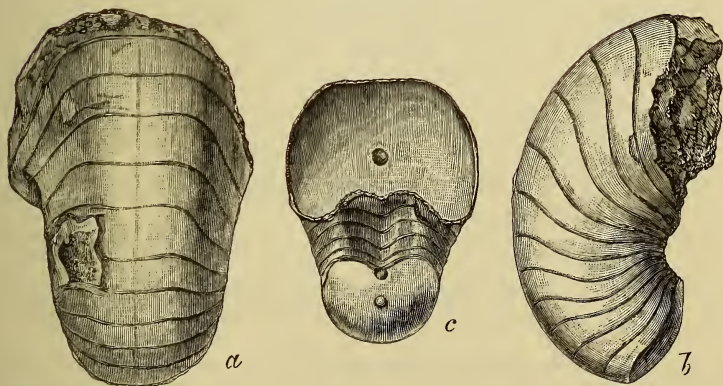
Localities. *British.* Burton-Bradstock, Dorsetshire.—*Foreign.* Courcy, Normandy.

Represented in the Collection by a few examples.

***Nautilus multiseptatus*, Foord and G. C. Crick.**

1890. *Nautilus multiseptatus*, Foord and G. C. Crick, *Ann. & Mag. Nat. Hist.* ser. 6, vol. v. p. 283, f. 13.

Fig. 48.



Nautilus multiseptatus.—*a*, peripheral view of the septate part of the shell, showing the sutures and "normal line;" *b*, lateral view of the same; *c*, interior whorl of another specimen, showing the siphuncle and the inner (dorsal) lobe of the sutures. Drawn from specimens in the British Museum (No. 82379). *a* and *b* rather more than half natural size; *c*, natural size.

Sp. Char. "Shell compressed at the sides and somewhat flattened on the periphery, so that the whorls have a subquadrate section. Umbilicus open, of moderate size, with rather steeply sloping sides, probably exposing the inner whorls, but the specimens are not complete enough to determine the amount of enrolment. Septa very numerous, thirteen in about half a volution; sutures gently curved upon the sides of the shell and nearly straight upon the periphery. Internal (dorsal) lobe very conspicuous (see fig. 48, *c*). The cast is marked with a very distinct 'normal line' along the median line of the periphery (see fig. 48, *a*). Siphuncle below the centre. Some detached body-chambers, probably belonging to this species, have portions of the test preserved, and this is quite smooth.

Remarks. "This species appears to be nearly related to *Nautilus obesus* (see fig. 45), but it is distinguished by its closer septa, the position of its siphuncle, its more slender whorls, and narrower periphery.

"The specimens were all obtained in the Northamptonshire Ironstone, and from most of them the shell has been dissolved away, leaving hollow spaces surrounding the casts." (*Foord and G. C. Crick.*)

Horizon. Inferior Oolite.

Locality. Duston, Northamptonshire.

Well represented in the Collection.

***Nautilus Baberi*, Morris and Lycett.**

1850. *Nautilus Baberi*, Morris and Lycett, A Monograph of the Mollusca from the Great Oolite, pt. i. p. 10, pl. i. ff. 1, 1 *a*.

1854. *Nautilus Baberi*, Morris, Catalogue of British Fossils, 2nd ed. p. 306.

1870. *Nautilus Baberi*, Sharp, Quart. Journ. Geol. Soc. vol. xxvi. p. 384.

1871. *Nautilus Baberi*, Phillips, Geology of Oxford and the Valley of the Thames, pp. 177, 243.

1873. *Nautilus Baberi*, Sharp, Quart. Journ. Geol. Soc. vol. xxix. p. 289.

1875. *Nautilus Baberi*, Etheridge, in J. W. Judd's Geology of Rutland (Mem. Geol. Surv. Great Britain), p. 204, and Appendix, p. 238.

Sp. Char. "A compressed, smooth shell, or only slightly marked by the lines of growth, with angular embracing volutions, leaving but a faint trace of an umbilical cavity; aperture somewhat quadrilateral, narrowed above, and wider than it is long; the septa are slightly sinuous, curving towards the umbilicus and outer margin.

"This species is allied to *N. truncatus*, Sow., from the Lias, but

is distinguished by the form of the mouth, and character of the septa." (*Morris and Lycett.*)

Remarks. This species bears some resemblance also to *Nautilus subtruncatus*, M. and L., but it is a more compressed shell, and not so short and thick as the latter. The specimen of *N. Baberi* described by Morris and Lycett must have been badly preserved, as is usually the case with the Minchinhampton fossils, because those authors describe the species as having a smooth shell, only slightly marked by the lines of growth, whereas the test (fragments of which are preserved upon some of the specimens in the British Museum¹) bears numerous very strong irregular transverse folds, resembling those of *N. subtruncatus*, though not so numerous. Another point in which these two species differ may be here mentioned, and that is, the present species is narrowly umbilicated, but in *N. subtruncatus* the umbilicus is entirely closed.

I am in doubt whether the specimens numbered 19528 (from Blisworth) and 20745 *a* (from Woodford) are rightly referred to this species, both specimens being very imperfect; they show, however, strong transverse ridges.

Horizon. Inferior Oolite. Great Oolite.

Localities. Blisworth, Woodford Road, Northamptonshire (Inf. Ool.); Bedford (Great Ool.); Kingsthorpe, Northamptonshire; Stamford, Lincolnshire (Great Ool.).

Well represented in the Collection, which contains, amongst others, three fine specimens (numbered C. 1545 and C. 1546) presented by F. W. Crick, Esq., of Bedford, and another (No. C. 478) by his son G. C. Crick, Esq., F.G.S., of this Museum.

***Nautilus subtruncatus*, Morris and Lycett.**

1850. *Nautilus subtruncatus*, Morris and Lycett, A Monograph of the Mollusca from the Great Oolite, pt. i. p. 10, pl. i. ff. 2, 2 *a*.

1845. *Nautilus subtruncatus*, Morris, Catalogue of British Fossils, 2nd ed. p. 307.

1858. *Nautilus subtruncatus*, Oppel, Die Juraformation Englands, Frankreichs, und des südwestlichen Deutschlands, p. 472.

1870. *Nautilus subtruncatus*, Sharp, Quart. Journ. Geol. Soc. vol. xxvi. p. 384.

1873. *Nautilus subtruncatus*, Sharp, Quart. Journ. Geol. Soc. vol. xxix. p. 290.

1875. *Nautilus subtruncatus*, Etheridge, in J. W. Judd's Geology of Rutland (Mem. Geol. Surv. of Great Britain), Appendix, p. 288.

¹ See especially the two examples numbered C. 1546.

Sp. Char. "A smooth, or slightly furrowed, and somewhat inflated shell, with rounded and embracing volutions in the young state, which become truncate, or subquadrate, in the adult, and having a very shallow, or slightly impressed, umbilicus. Aperture about twice as wide as it is high, flattened above, and somewhat compressed laterally.

"This shell has the general form of the *N. latidorsatus*, d'Orb. [= *Toarcensis*, d'Orb.], but the broad umbilicus and more quadrate form of the young shell in that species readily distinguish them. This species belongs to the section of the imperforate Nautili, of which *N. truncatus*, Sow., *N. clausus*, d'Orb., are examples; a group, the species of which were not apparently numerous during the Jurassic period." (*Morris and Lycett.*)

Remarks. This species finds its nearest ally in *Nautilus clausus*, d'Orbigny, but the latter has much more flexuous septa, as carefully indicated in d'Orbigny's plate (Terr. Jurass. pl. xxxiii. fig. 4), besides which the periphery is much narrower than is the case in Morris and Lycett's species.

N. Baberi has already been compared with this species, under the description of the former.

A specimen in the Collection from the Great Oolite of Kingsthorpe, Northamptonshire (No. 82345), may belong to this species; it is a fragment of the septate part of the shell; it shows no sculpture.

I have referred a specimen from the Inferior Oolite of Les Moutier, Calvados, to the present species on account of the close resemblance to the latter in the form of its shell, though the test is almost smooth, with, however, indications of ribbing on the sides of the shell. It may be a variety of Morris and Lycett's species.

None of the specimens from Minchinhampton have the septa preserved, the inside of one which was broken open being partly hollow and lined with crystals of calc-spar.

The specimen from Kingsthorpe exhibits rather approximate, slightly flexuous septa.

Horizon. Inferior Oolite. Great Oolite.

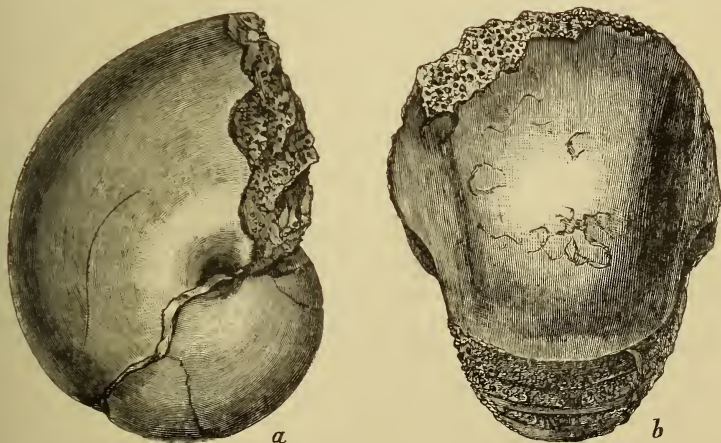
Localities. Minchinhampton, Gloucestershire (Inferior Oolite); Kingsthorpe, Northamptonshire (Great Oolite).

Well represented in the Collection.

***Nautilus clausus*, d'Orbigny.**

1842. *Nautilus clausus*, d'Orbigny, Paléontologie Française, Terr. Jurass. vol. i. p. 158, pl. xxxiii.
1849. *Nautilus clausus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 260.
1852. *Nautilus clausus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 155.
1858. *Nautilus clausus*, Quenstedt, Der Jura, p. 350.
1858. *Nautilus clausus*, Chapuis, Nouv. Rech. sur les Foss. des Terr. Secondaires de la Province de Luxembourg (Acad. Roy. de Belgique, tom. xxxiii. des Mém.), pt. i. p. 14, pl. iii. f. 1.
1860. *Nautilus clausus*, Wright, Quart. Journ. Geol. Soc. vol. xvi. p. 13.
1860. *Nautilus clausus*, Coquand, Synop. des Foss. Secondaires de la Charente, de la Charente-Inférieure, et de la Dordogne, p. 9.
1864. *Nautilus clausus*, Ebray, Études Géologiques sur le Département de la Nièvre, fasc. 13, 14, p. 270.
1863. *Nautilus clausus*, Dewalque, Prodrome d'une Description Géologique de la Belgique, p. 352.
1873. *Nautilus clausus*, Sharp, Quart. Journ. Geol. Soc. vol. xxix. p. 299.
- ? 1878. *Nautilus clausus*, Bayle, Explication de la Carte Géologique de la France, vol. iv., Atlas, pl. xxxvi.

Fig. 49.



Nautilus clausus.—*a*, lateral view, showing the septate part of the shell covered with the test, and the cast of the body-chamber with part of the anterior border of the muscular impression, represented by the curved line; *b*, peripheral view, showing some of the septa, at the lower part of the figure. Drawn from a specimen in the d'Orbigny Collection of the Museum of Natural History, Paris. About one half natural size.

1884. *Nautilus clausus*, Mallada, Boletín de la Comisión del Mapa Geológico de España, vol. xi., Sinopsis de las Especies Fósiles de España, p. 228 (p. 20 of the Sinopsis).

1890. *Nautilus clausus*, Foord and G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 284, f. 14.

Sp. Char. "Shell inflated, rapidly enlarging, somewhat compressed on the sides, broad and flattened on the periphery; surface of test smooth or marked only with very fine subregular lines of growth. Whorls completely involute, widest in the region of the umbilicus, which is closed by a shelly callus. Aperture much wider than high. Septa slightly curved on the sides and forming a shallow sinus on the periphery. Siphuncle a little below the centre.

Remarks. "This species bears some resemblance to *Nautilus subtruncatus*, Morris and Lycett¹, and it is also like *N. Baberi* of the same authors; it differs from the former in its smooth test and from the latter in the same feature and also in its closed umbilicus.

"Fig. 50 was traced from a young specimen (2 inches in diameter) of this species from the Inferior Oolite of Caen, Normandy (No. 37024). The anterior boundary (*a*) of the impression of the shell-muscle can be distinctly followed from the umbilicus on the

Fig. 50.



one side across the periphery to the umbilicus on the other; but no trace exists of the posterior boundary. The letter *s* represents the last septum.

"Figures 46 and 50 show how closely the Jurassic species of *Nautilus* approximate, as regards their muscular attachment, to the recent *Nautilus*; and this analogy may be carried still further back in geological time judging by the figure of a Triassic species (*N. salinarius*) given by Mojsisovics², in which a considerable portion of the anterior boundary of the shell-muscle is preserved.

"We have lately had the great advantage of examining a specimen of the present species from the d'Orbigny Collection of the Museum

¹ Monograph of the Mollusca from the Great Oolite, Pal. Soc. 1850, pt. i. p. 10, pl. i. figs. 1, 2.

² "Die Cephalopoden der Mediterranen Trias-Provinz" (Abh. d. k.-k. geol. Reichsanst. Band x.), 1882, pl. xci. fig. 3a.

of Natural History, Paris, and there is in the British Museum a good representative of it from Moutiers (Calvados). We have also seen a young specimen in the Woodwardian Museum, Cambridge, which appears to belong to this species; it is from Dundry, the only British locality mentioned by d'Orbigny. *N. clausus* is evidently rare in England, for it is not recorded in any of the papers on the geology of Somerset, by Etheridge, Tawney, and Stoddart, and Mr. E. Wilson has informed us that there are no examples of it in the Bristol Museum. Under these circumstances the determination of this species by Wright from Leckhampton Hill (Gloucestershire), and by Sharp¹ from the Northampton Sands, must, in the absence of descriptions and figures, be accounted of doubtful accuracy. The finest specimen of this species that we have seen is from Sherborne, Dorsetshire; it measures 9 inches in diameter and $6\frac{1}{4}$ inches in width." (*Foord and G. C. Crick.*)

The specimen here described now forms part of the National Collection (No. C. 3189).

Horizon. Inferior Oolite.

Localities. *British.* Dundry, Somersetshire; Halfway House, Dorsetshire.—*Foreign.* Montiers, Caen (Calvados), France.

Well represented in the Collection.

***Nautilus lineolatus*, Foord and G. C. Crick.**

1890. *Nautilus lineolatus*, Foord and G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 393. (No figure.)

Sp. Char. "Shell thick, somewhat inflated on the sides, with a broad and flattened periphery; greatest breadth of the whorls at about the middle of the sides; aperture wider than high, presenting a distinctly subquadrate section. Umbilicus very small and deep, with rounded border. Septa moderately distant; sutures rather concave on the sides of the shell and forming a very slight sinus on the periphery. Siphuncle not seen. Test thick, ornamented with subregular lines of growth.

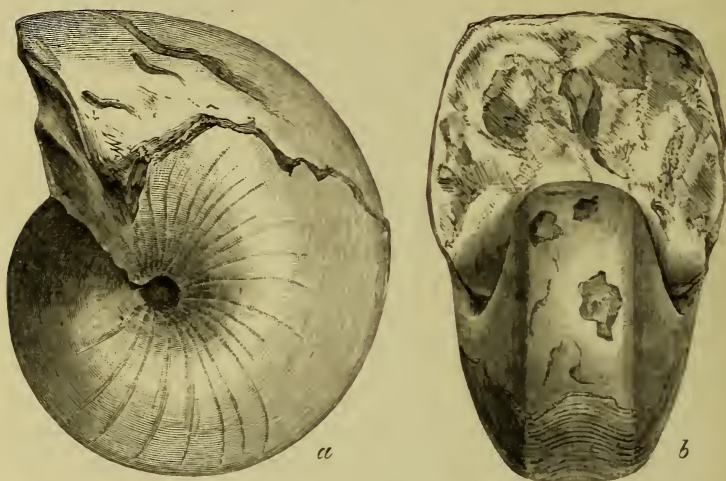
"A large example (No. C. 3188) from Vetney Cross, Dorsetshire, measures 6 inches in diameter and 4 inches in its greatest breadth.

Remarks. "This species is closely allied to *Nautilus clausus*, d'Orbigny, but it is distinguished by its less rapid rate of increase, by its open umbilicus, and, on the whole, by its more compressed form. The body-chamber of a young example (No. 36952) exhibits traces of the anterior border of the impression of the shell-muscle.

¹ For references to these authors' papers see the table of synonymy above.

. . . A small specimen from the Upper Lias of Fontaine-Étoupe-Four probably belongs to this species." (Foord and G. C. Crick.)

Fig. 51.



Nautilus lincolatus.—*a*, lateral view, showing the small umbilicus and the thick, smooth test, partly removed from the body-chamber: *b*, front view, showing the flattened periphery. Drawn from a specimen in the British Museum (No. C. 3188). Rather more than two fifths natural size.

Horizon. Upper Lias (France). Inferior Oolite (England).

Localities. *British*. Yeovil, Somersetshire (No. 36952); Vetney Cross, Dorsetshire.—*Foreign*. Fontaine-Étoupe-Four (Calvados), France.

Well represented in the Collection.

***Nautilus perinflatus*, Foord and G. C. Crick.**

1890. *Nautilus perinflatus*, Foord and G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 286, f. 15.

Sp. Char. "Shell much inflated, very slightly flattened on the sides; peripheral area scarcely defined. Whorls semilunate in section, rather more than twice as wide as high, deeply embracing. Umbilicus very small. Septa rather approximate; sutures slightly curved on the sides of the shell and forming a shallow sinus on the periphery. Siphuncle near the inner margin. Test thick, marked only with lines of growth.

Remarks. "This species closely resembles the *N. subinflatus* of

d'Orbigny¹, but differs in the position of its siphuncle and the greater size of the shell. Moreover, the examples upon which

Fig. 52.



Nautilus perinflatus.—*a*, lateral view of septate part of the shell, showing the small umbilicus, with a portion of the test; *b*, front view, showing the position of the siphuncle. Drawn from a specimen in the British Museum (No. 18398). Rather more than one third natural size.

d'Orbigny's species was founded were obtained from the Kimmeridge Clay of Chatelaillon, near Rochelle (Charente-Inférieure), Honfleur (Calvados), and other localities, whereas the English specimens are from the Inferior Oolite of Bradford-Abbas, Dorsetshire, and Bristol.

"The largest specimen known to us is from the Inferior Oolite of Sherborne, Dorsetshire; its greatest diameter is 8 inches and greatest width $6\frac{1}{2}$ inches. Distinct traces of the anterior border of the muscular impression are observable on the cast of its body-chamber." (*Foord and G. C. Crick.*)

The fine specimen here described now belongs to the British Museum (No. 3182).

Horizon. Inferior Oolite.

Localities. Bradford-Abbas, Sherborne, Dorsetshire; Bristol, Gloucestershire.

Well represented in the Collection.

¹ Prodr. de Paléont. Stratigr. 1850, vol. ii. p. 43; this species was originally called *inflatus* (Paléont. Franç., Terr. Jurass. 1842, vol. i. p. 165, pl. xxxvii.).

***Nautilus excavatus*, J. de C. Sowerby.**

1826. *Nautilus excavatus*, J. de C. Sowerby, Min. Conch. vol. vi. p. 55, pl. dxxix. f. 1.
1842. *Nautilus excavatus*, d'Orbigny, Paléontologie Française (Terrains Jurassiques), vol. i. p. 154, pl. xxx.
1849. *Nautilus excavatus*, d'Orbigny, Prodrome de Paléontologie Stratigraphique, vol. i. p. 260.
1852. *Nautilus excavatus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 160.
1854. *Nautilus excavatus*, Morris, Catalogue of British Fossils, 2nd ed. p. 306.
1858. *Nautilus excavatus*, Ooster, Catalogue des Céphalopodes Fossiles des Alpes Suisses, pt. iii. p. 8.
1860. *Nautilus excavatus*, Coquand, Synop. des Foss. Second. de la Charente, de la Charente-Inférieure, et de la Dordogne, p. 9.
1860. *Nautilus excavatus*, Wright, Quart. Journ. Geol. Soc. vol. xvi. pp. 23, 24.
1878. *Nautilus excavatus*, Bayle, Explication de la Carte Géologique de la France, vol. iv., Atlas, pl. xxxvii.
1879. *Nautilus excavatus*, Stoddart, Proc. Bristol Naturalists' Soc. vol. ii. pt. iii. p. 279.
1883. *Endolobus excavatus*, Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 288.
1884. *Nautilus excavatus*, Mallada, Boletín de la Comisión del Mapa Geológico de España, vol. xi. Sinopsis de las Especies Fósiles de España, p. 228.

Sp. Char. "Nearly globose, smooth; sides excavated by a very large conical umbilicus. . . . The whorls of this *Nautilus* increase very rapidly: they are so wide that they would produce a spherical form, were it not for the large umbilicus which occupies nearly half the diameter of the shell. The front of the aperture is arched; the sides straight, converging towards the preceding whorl; the siphuncle nearly central." (*Sowerby*.)

Remarks. This species is distinguished from all other Jurassic forms by the extraordinary width of the aperture in comparison with the height, and by the great size and depth of the umbilicus. All the inner whorls are exposed in the umbilicus, which has a small central perforation. There is a well-developed dorsal lobe.

Hyatt¹ regards this species as the "latest survivor" of the Carboniferous genus *Endolobus* of Meek and Worthen (= *Temnocheilus*), and there is certainly a considerable resemblance between the present species and *Nautilus spectabilis*, M. & W.², the type of

¹ Proc. Boston Soc. Nat. Hist. vol. xxii. 1883, p. 288.

² Geol. Surv. of Illinois, 1866, vol. ii., Palæontology, p. 308, pl. xxv. ff. 1 a, 1 b.

Endolobus, but one meets with nothing in the Trias to connect these widely separated forms.

Horizon. Inferior Oolite.

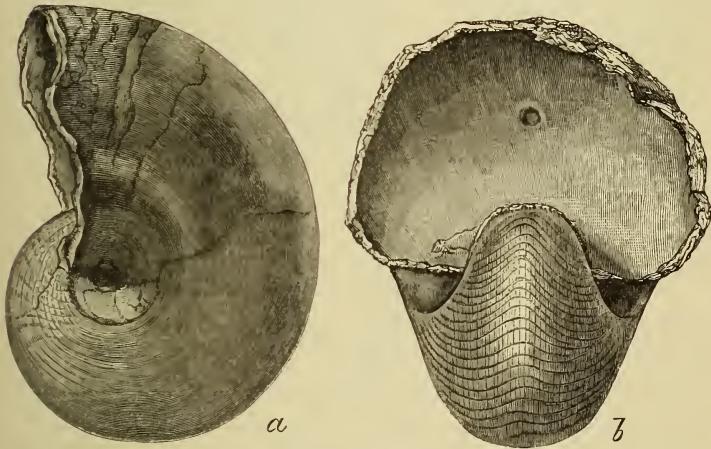
Localities. *British.* Burton-Bradstock, Halfway House, Bridport, Dorsetshire.—*Foreign.* Bayeux, St. Vigor (Calvados), France.

Well represented in the Collection, which includes ("Sowerby Coll.") Sowerby's type, figured in the 'Mineral Conchology.'

***Nautilus Smithi*, Foord and G. C. Crick.**

1890. *Nautilus Smithi*, Foord and G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 287, f. 16.

Fig. 53.



Nautilus Smithi.—*a*, lateral view; *b*, front view, showing the ornaments of the young shell and also the position of the siphuncle. Drawn from a specimen in the British Museum (No. C. 747). About two thirds natural size.

Sp. Char. "Shell inflated, rapidly increasing, slightly compressed on the sides, broadly rounded on the periphery. Whorls much wider than high, widest in the region of the umbilicus. The latter is small, with a subangular margin and steeply sloping sides. The septa are rather distant from each other on the periphery, being half an inch apart where the height of the whorl is $1\frac{3}{4}$ inches. The sutures are but slightly curved on the sides and form a very shallow sinus on the periphery. The siphuncle is slightly above the centre. The test is ornamented with fine lines of growth, which tend to gather into obscure folds and form a deep sinus on the peri-

phery; these are crossed by close-set longitudinal lines, more distinct in the young shell.

Remarks. "The chief distinguishing character of this species is the subangular border of the umbilicus. In this last feature, and also in the wide and semilunate section of the whorl, this species resembles *Nautilus excavatus*¹; but the latter has a much larger umbilicus and closer septa. It may also be compared with *N. Malherbi*, Terquem²; but the latter is at once distinguished by its less globose form and much larger umbilicus.

"The type of this species (No. C. 747) is in the 'Wm. Smith Collection;' hence the specific name. There is a fine example from Sherborne, Dorsetshire, in the Woodwardian Museum, Cambridge, in which the test is beautifully preserved. Two smaller ones in the same Museum are from Halfway House, Dorsetshire, and one shows the sculpture of the young shell perfectly." (*Foord and G. C. Crick.*)

Horizon. Inferior Oolite.

Localities. Burton-Bradstock, Halfway House, Bradford-Abbas, Dorsetshire. Two specimens in the British Museum (Nos. C. 747 and C. 3095) are without localities, but are undoubtedly British.

Well represented in the Collection.

***Nautilus Burtonensis*, Foord and G. C. Crick.**

1890. *Nautilus Burtonensis*, Foord and G. C. Crick, *Ann. & Mag. Nat. Hist.* ser. 6, vol. v. p. 288, f. 17.

Sp. Char. "Shell subglobose, compressed on the sides and periphery, the latter at first narrow and considerably flattened, but in the later stages of growth becoming wider and more rounded. The umbilicus is very large in proportion to the shell-diameter, its greatest width being $1\frac{1}{2}$ inches, while that of the shell is about 5 inches; it is moderately deep and exposes all the inner whorls; the sides slope steeply, and the outer border is subangular. The test, which is admirably preserved, is thick, and its surface is marked only with fine lines of growth, which make a deep sinus upon the periphery (see fig. 54, b). The septa are rather wide apart; the sutures slightly sinuous on the sides of the shell and forming a slight sinus on the periphery. In a young shell ($2\frac{1}{4}$

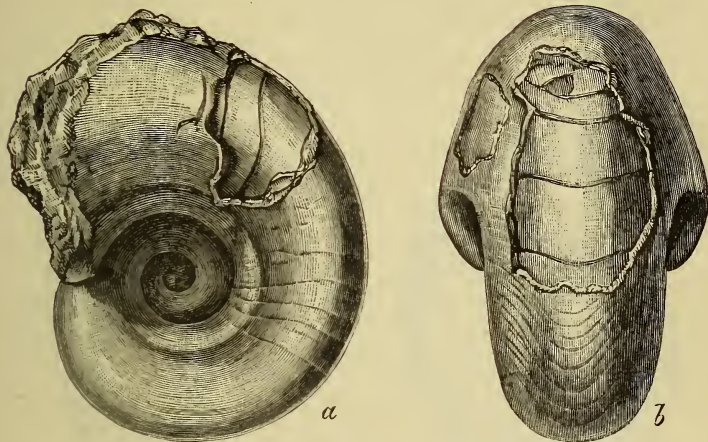
¹ J. de C. Sowerby, *Min. Conch.* vol. vi. p. 55, pl. dxxix. fig. 1.

² *Mém. Soc. Géol. France*, sér. ii. vol. v. pt. ii. 1855, p. 243, pl. xii. figs. 5, 5a, 5b.

inches in diameter) the inner lobe is very conspicuous. The siphuncle is a little below the centre.

Remarks. "This fine species is unlike any other known to us in the Jurassic rocks, but it bears some resemblance to the recent

Fig. 54.



Nautilus Burtonensis.—*a*, lateral view, showing the large umbilicus exposing the inner whorls; *b*, peripheral view, showing some of the sutures where the test is removed. Drawn from a specimen in the British Museum (No. C. 2841). Somewhat less than half the natural size.

Nautilus umbilicatus in the character of its umbilicus, from which species it differs, however, in the proportionately greater size of its umbilicus and more flattened periphery." (*Foord and G. C. Crick.*)

Horizon. Inferior Oolite.

Locality. Burton-Bradstock, Dorsetshire.

Well represented in the Collection.

***Nautilus Calloviensis*, Oppel.**

? 1840. *Nautilus hexagonus*?, J. de C. Sowerby, in Grant's "Fossils of Kutch" in Trans. Geol. Soc. ser. ii. vol. v. pt. ii. p. 329, pl. xxiii. f. 4. (*Not of Sowerby.*)

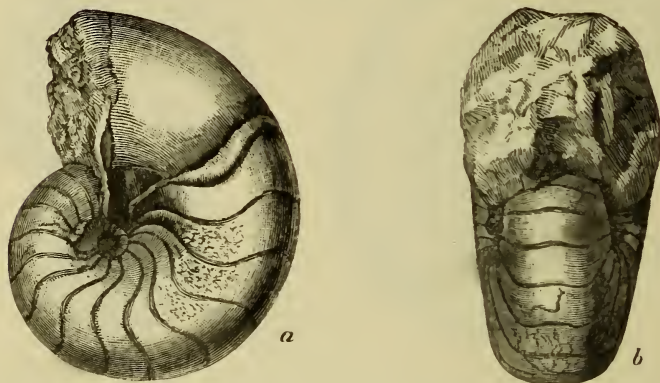
1842. *Nautilus hexagonus*, d'Orbigny, Paléontologie Française, Terr. Jurass. vol. i. p. 161, pl. xxxv. ff. 1, 2. (*Not of Sowerby.*)

1858. *Nautilus Calloviensis*, Oppel, Die Juraformation Englands, Frankreichs und des südwestlichen Deutschlands, p. 547.

1875. *Nautilus Calloviensis*, Waagen, Mem. Geol. Surv. India—Palæont. Indica—Jurassic Fauna of Kutch, vol. i. p. 18, pl. iii. ff. 2, *a, b*.

1884. *Nautilus Calloviensis*, Lahusen, Mémoires du Comité Géologique [Russia], vol. i. no. 1, p. 42, tab. iii. ff. 28, *a*, *b*, and 29, *a*, *b* (young).
 1884. *Nautilus hexagonus*, Mallada, Boletín de la Comisión del Mapa Geológico de España, vol. xi. Sinopsis de las Especies Fósiles de España, p. 229 (figured 1878, vol. v. pl. iv. f. 9).
 1890. *Nautilus Calloviensis*, Foord and G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 289, f. 18.

Fig. 55.



Nautilus Calloviensis.—*a*, lateral view of a cast, showing the septation and part of the body-chamber; *b*, front view. Drawn from a specimen in the British Museum (No. 88979). Nearly two thirds natural size.

Sp. Char. “General form of the shell somewhat compressed, smooth, or marked only by faint, very fine, close-set lines of growth. The whorls are obtusely angular, flattened at the sides, and broadly truncated upon the periphery, the greatest thickness being at the umbilical margin. The umbilicus is very small. The septa form a sigmoid curve upon the sides of the shell and are slightly sinuous upon the periphery. Siphuncle central. The ornaments of the test are described more exactly by Dr. Waagen¹ as follows:— ‘The shell itself is covered with two systems of fine striæ, of which the parallel ones, which follow the direction of the spiral, are limited to the external part of the shell. The others—striæ of growth—cover the whole shell, are somewhat falciform on the sides, but bend strongly backward on the external part. On very large specimens these lines become very strong and numerous, and look as if cut in

¹ Mem. Geol. Surv. India—Palæont. Indica—Jurassic Fauna of Kutch, vol. i. p. 18.

with a knife; the other system of striae then entirely disappears. . . . On the cast the normal line is often very strongly pronounced.'

Remarks. "This species is rather near to *N. lineatus*, but it is distinguished by its more sinuous and approximate septa and narrower umbilicus.

"The differences which separate the present species from *N. hexagonus*, J. de C. Sowerby, have been pointed out by that author in his description of the Kutch fossils collected by Captain Grant¹. He says, 'This [*N. hexagonus*?] differs from *N. hexagonus* in having a smaller umbilicus and in being more rounded.'

"Oppel distinguished this species from Sowerby's by its wider aperture; it may also be known by its deeply-lobed sutures, in which character it approaches *Nautilus (Hercoglossa) Franconicus*, Oppel." (*Foord and G. C. Crick.*)

Horizon. Calcareous Grit and Kelloway Rock.

Localities. Wiltshire; Marcham, Berkshire (Calcareous Grit); Scarborough, Yorkshire (Kelloway Rock).

Well represented in the Collection.

***Nautilus hexagonus*, J. de C. Sowerby.**

- 1825. *Nautilus gigas*, d'Orbigny, Annales des Sciences Naturelles, vol. v. pl. vi. f. 3. (*Not of Zieten.*)
- 1826. *Nautilus hexagonus*, J. de C. Sowerby, Min. Conch. vol. vi. p. 55, pl. dxxix. f. 2.
- 1835. *Nautilus hexagonus*?, Phillips, Geology of Yorkshire, 2nd ed. pt. i. p. 113.
- 1841. *Nautilus hexagonus*, Williamson, Trans. Geol. Soc. ser. ii. vol. vi. pt. i. p. 152.
- 1842. *Nautilus giganteus*, d'Orbigny, Paléontologie Française (Terrains Jurassiques), vol. i. p. 163, pl. xxxvi.
- 1845. *Nautilus hexagonus*?, Murchison, Outline of the Geology of the Neighbourhood of Cheltenham, new ed. p. 80.
- 1849. *Nautilus giganteus*, d'Orbigny, Prodrôme de Paléontologie Stratigraphique, vol. i. p. 348.
- 1852. *Nautilus hexagonus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 155.
- 1854. *Nautilus hexagonus*, Morris, Catalogue of British Fossils, 2nd ed. p. 307.
- 1858. *Nautilus hexagonus*, Ooster, Catalogue des Cephalopodes, Fossiles des Alpes Suisses, pt. iii. p. 8.
- 1859. *Nautilus giganteus*, Thurmann et Etallon, Lethea Bruntrutana, p. 74, pl. i. f. 2.

¹ Trans. Geol. Soc. ser. ii. vol. v. pt. ii. 1840, Explanation of Plates.

1860. *Nautilus hexagonus*, Wright, Quart. Journ. Geol. Soc. vol. xvi. p. 27.
1864. *Nautilus hexagonus*, Eudes-Deslongchamps, Études sur les Étages Jurassiques Inférieurs de la Normandie, p. 149.
1864. *Nautilus hexagonus*, Ebray, Études Géologiques sur le Département de la Nièvre, fasc. 13, 14, p. 236.
1864. *Nautilus hexagonus*, Damon, Supplement to the Handbook to the Geology of Weymouth and the Isle of Portland, pl. v. f. 10.
1871. *Nautilus hexagonus*, Phillips, Geology of Oxford and the Valley of the Thames, pp. 305, 323.
1873. *Nautilus hexagonus*, Sharp, Quart. Journ. Geol. Soc. vol. xxix. p. 290.
1876. *Nautilus hexagonus*, Hudleston, Proc. Geol. Association, vol. iv. No. 6 ("The Yorkshire Oolites"), pp. 373, 388.
1878. *Nautilus hexagonus*, Hudleston, *ibid.* vol. v. No. 8, p. 482.
1881. *Nautilus hexagonus*, Etheridge, in Fox-Strangway's Geology of the Oolitic and Liassic Rocks to the North and West of Malton (Mem. Geol. Surv. Great Britain), p. 20.

Sp. Char. "Short cylindrical; sides depressed, conical; front broad, straight; umbilicus small; aperture sagittate, truncated; siphuncle nearest the inner edge of the septum.

"In this species the septa are rather numerous and not much curved; its most remarkable character is the straightness of the lines that bound a section of it in the plane of the aperture, which section, being an elongated hexagon, has suggested the name." (*Sowerby.*)

Remarks. It is highly probable that the *Nautilus giganteus* of d'Orbigny is identical with the present species, but without seeing the original specimen it would not be possible to decide the point, as d'Orbigny's figures in the 'Annales des Sciences Naturelles' disagree very materially with those of the 'Paléontologie Française.'

There is a very large specimen in the Collection which yields the following measurements, viz. greatest diameter 15 inches, umbilicus about 2 inches across, greatest breadth of the shell about 10 inches.

Horizon. Stonesfield Slate; Oxford Clay (including the Kelloway Rock); Corallian; Kimmeridge Clay.

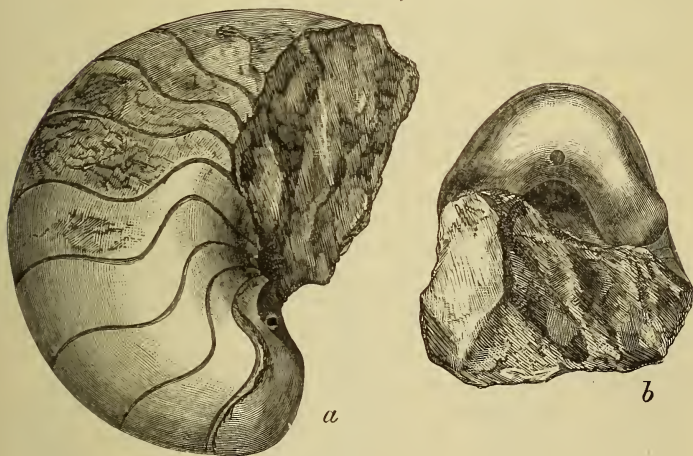
Localities. *British.* Chippenham, Wiltshire; Weymouth, Dorsetshire (Oxford Clay and Kelloway Rock); Scarborough, Yorkshire (Kelloway Rock); Hinton, near Trowbridge, Wiltshire; Yorkshire (Calcareous Grit); Blisworth, Northamptonshire (Kimmeridge Clay); Stonesfield (Stonesfield Slate).—*Foreign.* Havre, France (Kimmeridge Clay).

Well represented in the Collection.

Subgenus **HERCOGLOSSA.**[See *suprà*, p. 180.]**Nautilus (Hercoglossa) aganiticus**¹, Schlotheim.

1820. *Nautilites aganiticus*, Schlotheim, Die Petrefactenkunde, p. 83.
 1853. *Nautilus aganiticus*, Oppel, Die Juraformation Englands, Frankreichs und des südwestl. Deutschlands, p. 686.
 1863. *Nautilus aganiticus*, Zittel, Die Cephalopoden der Stramberger Schichten, in Oppel and Zittel's Palæontologische Mittheilungen, Band i. Abth. ii. p. 43.
 1890. *Nautilus (Hercoglossa) Aganiticus*, Foord and G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 393, f. 1.

Fig. 56.



Nautilus (Hercoglossa) aganiticus.—*a*, lateral view of an imperfect specimen, showing the deeply lobed sutures; *b*, view of the septum which faces the letter *a* in the other figure, showing the position of the siphuncle. Drawn from a specimen in the British Museum (No. C. 3173). A little more than one half natural size.

Sp. Char. “Shell somewhat inflated, slightly compressed on the sides, rather narrowly rounded on the periphery; umbilicus very small, or perhaps closed. Septa wide apart, being 9 lines distant

¹ Probably intended as an adjectival form of *Aganides*, which is said to be derived from *ἀγαρός*, *amēnus*, “pleasant to the sight.”

from each other where the height of the whorl is 2 inches. Sutures strongly arched forward after leaving the umbilicus, then sweeping backward in a larger curve, and again forward towards the periphery, which they cross without forming any sinus. Siphuncle situated a little below the centre.

Remarks. "This species was long confounded with another from a higher horizon (the Tithonian), afterwards designated by Oppel *Franconicus*¹. The present species is now restricted to a form found in the Eisenoolith of Villecomte in Lothringen (Lorraine)². *N. aganiticus* is easily distinguished from *N. Franconicus* by its much more inflated form, rounded periphery, somewhat less flexuous sutures, and the position of its siphuncle. In its general form, especially in the rounding of the periphery, this species bears a much closer resemblance to *Nautilus (Hercoglossa) Portlandicus*, which, however, differs in the form of its sutures. . . ." (*Foord and G. C. Crick.*)

Horizon. Inferior Oolite (Middle Brown Jura).

Locality. Villecomte, Lothringen.

***Nautilus (Hercoglossa) Franconicus*, Oppel.**

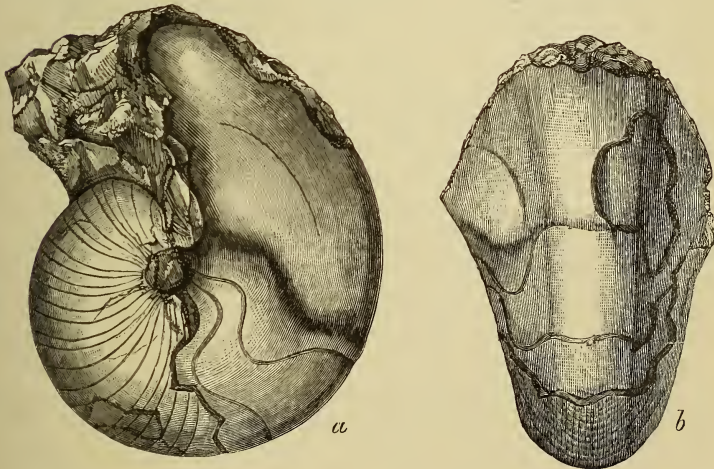
1832. *Nautilus aganiticus*?, Bronn, in Leonhard & Bronn's Jahrbuch für Mineralogie &c. p. 70.
1837. *Nautilus aganiticus*, von Buch, Ueber den Jura in Deutschland (Akad. der Wissensch.), p. 119.
1849. *Nautilus aganiticus*, Quenstedt, Die Cephalopoden, p. 58, Tab. ii. f. 6. (*Not* of Schlotheim.)
1865. *Nautilus Franconicus*, Oppel, Die Tithonische Etage, Zeitschr. der Deutsch. geol. Gesell. Band xvii. p. 546.
- ? 1865. *Nautilus Strambergensis*, Oppel, *ibid.*
- ? 1868. *Nautilus Strambergensis*, Zittel, Die Cephalopoden der Stramberger Schichten, in Oppel and Zittel's Palæontologische Mittheilungen, Band i. Abth. ii. p. 42, Atlas, Taf. ii. ff. 8-11.
1870. *Nautilus aganiticus*, F. Roemer, Geologie von Oberschlesien, p. 252, Taf. xxiv. f. 6.
1871. *Nautilus* cf. *Strambergensis*, Herbich, Verh. u. Mitth. des naturwiss. Vereines zu Herrmanstadt.
1873. *Nautilus Franconicus*, Neumayr, Die Fauna der Schichten mit *Aspidoceras acanthicum*, Abhandl. der k.-k. geol. Reichsanst. Band v. Heft 6, p. 156.

¹ Oppel, "Die Tithonische Etage," Zeitschr. der Deutsch. geol. Gesell., Band xvii. 1865, p. 546.

² Zittel, "Die Cephalopoden der Stramberger Schichten," Palæontologische Mittheilungen, Band i. Abth. ii. 1868, p. 43.

1875. *Nautilus Franconicus*, von Ammon, Die Jura Ablagerungen zwischen Regensburg und Passau, p. 163, Taf. i. f. 1.
1875. *Nautilus Franconicus*, Favre, Descr. des Foss. du Terr. Jurass. de la Montagne des Voirons (Savoie), Mém. Soc. Pal. Suisse, vol. ii. p. 16, pl. i. ff. 6 a, 6 b.
1876. *Nautilus Franconicus*, de Loriol, Mon. Pal. des Couches de la zone à *Ammonites tenuilobatus*, Mém. Soc. Pal. Suisse, vol. iii. pt. i. p. 13.
- ? 1877. *Nautilus aganiticus*, Blake and Hudleston, On the Coralline Rocks of England, Quart. Journ. Geol. Soc. vol. xxxiii. p. 400.
- ? 1878. *Nautilus aganiticus*, Hudleston, The Yorkshire Oolites, Proceed. Geologists' Association, vol. v. no. 8, p. 432.
1878. *Nautilus Franconicus*, Herbich, Das Széklerland mit Berücksichtigung der angrenzenden Landestheile (Mittheil. aus dem Jahrb. der Kön. Ungar. geol. Anstalt, Band v. Heft ii.), p. 139, Taf. i. f. 3.
1881. *Nautilus Franconicus*, Schlosser, Die Fauna des Kelheimer Dieras-Kalkes, Abth. i. p. 61; Palæontographica, Band xxviii.
1890. *Nautilus Franconicus*, Foord and G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 395, f. 2.

Fig. 57.



Nautilus (Hercoglossa) Franconicus.—*a*, lateral view, showing two of the septa, and a peculiar ridge at the base of the body-chamber; the curved line upon the cast of the latter is the anterior boundary of the impression of the shell-muscle; the test which covers the greater portion of the septate part of the shell is covered with fine lines of growth; they are a little too distinct in the engraving. *b*, peripheral view, showing the flattening of the sides and periphery. Drawn from a specimen in the British Museum (No. C. 3109). Nearly two thirds natural size.

Sp. Char. "Shell much compressed laterally, flattened upon the periphery: the latter broad, with (in the cast) rounded borders. The greatest width of the whorls is in the umbilical region. The umbilicus is very small. The septa are moderately distant, the sutures very strongly bent, first forward in a narrow lobe on leaving the umbilicus, then backward in a broader one, then sweeping forward again and making a conspicuous sinus on the periphery. The siphuncle is situated considerably above the centre.

Remarks. "Though Oppel, Zittel, and Neumayr unite in regarding *Nautilus Strambergensis* as a distinct species from the present one, the resemblance between the two is very striking. The only difference between them is in the form of the sutures, which make a wider (backwardly directed) lobe on the sides of the shell in *N. Franconicus* than they do in *N. Strambergensis*, and this distinction is expressed in the figures of the latter given by Zittel (*loc. cit.*), which otherwise agree perfectly with specimens of *N. Franconicus* with which we have compared them. The name *Franconicus* was originally conferred by Oppel¹ upon a specimen from the Lithographic Slate of Solenhofen.

"The locality of the specimen figured is unknown, but it agrees in all essential points with the German specimens in the Collection, and adds to our knowledge of the species the characters of the body-chamber and of the test. The latter is smooth, being ornamented only with delicate lines of growth. The last two septa are exposed by the removal of the test. A strong ridge is developed near the base of the body-chamber, its indented outline corresponding roughly with that of the last suture. Part of the anterior boundary of the shell-muscle is seen on the cast of the body-chamber (see fig. 57 a). The aperture is deeply emarginate.

"In an excellent figure of this species given by v. Ammon (*loc. cit.*) the anterior border of the shell-muscle is represented upon the cast of the body-chamber." (*Foord and G. C. Crick.*)

Horizon. Tithonian.

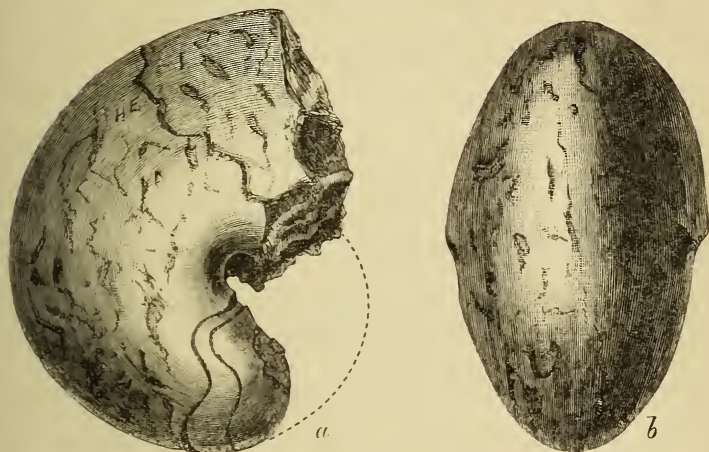
Localities. Normandy, Escragnolles (Var), France; Randen, near Schaffhausen, Switzerland; Einsingen, Württemberg.

¹ "Die Tithonische Etage" (Zeitschr. der Deutsch. geol. Gesell. Band xvii.), p. 546. The "Tithonian" is a special group of the Upper (White) Jura, including the period embraced between the Oxfordian and Portlandian series. See Oppel's 'Die Juraformation Englands, Frankreichs und des südwestlichen Deutschlands,' 1858; also Zittel, "Die Cephalopoden der Stramberger Schichten," Palæont. Mittheil. Band i. Abth. ii. 1868.

Nautilus (Hercoglossa) Portlandicus, Foord and
G. C. Crick.

1890. *Nautilus Portlandicus*, Foord and G. C. Crick, Ann. & Mag. Nat.
Hist. ser. 6, vol. v. p. 397, f. 3.

Fig. 58.



Nautilus Portlandicus.—*a*, lateral view, showing two of the septa and the siphuncle, which projects a little; *b*, peripheral view. Drawn from a specimen in the British Museum (No. 62165). About one sixth natural size.

Sp. Char. “Shell subglobose, narrowly rounded on the periphery, gently rounded on the sides, widest immediately above the umbilicus; the latter probably closed, or, if open, exceedingly small. Body-chamber forming probably half a volution. Aperture wider than high. Septa approximate, the sutures forming a very distinct sigmoidal curve on the sides of the shell; in passing over the periphery the sutures are slightly bent backwards. The siphuncle is nearly central. The test is not preserved.

Remarks. “The large specimen (No. 62165) upon which the above description is founded is very imperfect, all the inner whorls are wanting, only the two chambers nearest the body-chamber being preserved; nevertheless the species could be easily recognized by the form of the sutures and the narrowly rounded periphery. The dimensions of the fossil are as follows:—Greatest diameter about 13 inches, greatest breadth about $7\frac{1}{2}$ inches.”
(Foord and G. C. Crick.)

The differences between the present species and *Nautilus* (*Herzoglossa*) *aganiticus*, its nearest ally, have already been pointed out in the description of the latter.

Horizon. Portland Oolite¹.

Locality. Isle of Portland (?), Dorsetshire.

CRETACEOUS SPECIES.

***Nautilus sublævigatus*, d'Orbigny.**

- 1840. *Nautilus lævigatus*, d'Orbigny, Paléontologie Française (Terrains Crétacés), p. 84, pl. xvii.
- 1850. *Nautilus sublævigatus*, d'Orbigny, Prodrome de Paléontologie Stratigraphique, vol. ii. p. 189.
- 1850. *Nautilus lævigatus*, Geinitz, Das Quadersandsteingebirge oder Kreidegebirge in Deutschland, p. 110.
- 1852. *Nautilus cretaceus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 149.
- 1853. *Nautilus lævigatus*, Sharpe, Description of the Fossil Remains of Mollusca found in the Chalk of England, pt. i. Cephalopoda (Mon. Pal. Soc.), p. 11, pl. ii. ff. 1 a, 1 b, 2 a, 2 b.
- 1854. *Nautilus sublævigatus*, Millet, Paléontologie de Maine et Loire, p. 114.
- 1854. *Nautilus lævigatus*, Morris, Catalogue of British Fossils, 2nd ed. p. 307.
- 1858. *Nautilus cretaceus*, Ooster, Catalogue des Céphalopodes Fossiles des Alpes Suisses, pt. iii. p. 14.
- 1859. *Nautilus sublævigatus*, Pictet et Campiche, Descrip. des Fossiles du Terr. Crétacés des Environs de Sainte-Croix (Palæont. Suisse, sér. ii. pt. i. livr. vii.), p. 140.
- 1862. *Nautilus lævigatus*, Bristow and Etheridge, in Bristow's Geology of the Isle of Wight (Mem. Geol. Surv. of Great Britain, Sheet 10), p. 137.
- 1863. *Nautilus lævigatus*, Strombeck, Zeitschr. der Deutsch. geol. Gesell. vol. xv. p. 136 (partim).
- 1865. *Nautilus lævigatus*, Tate, Quart. Journ. Geol. Soc. vol. xxi. p. 28.
- 1866. *Nautilus sublævigatus*, Beltremieux, Faune Fossile du Département de la Charente-Inférieure, pp. 49, 80.
- 1869. *Nautilus sublævigatus*, Favre, Description des Mollusques Fossiles de la Craie des Environs de Lemberg, p. 9.
- 1870. *Nautilus lævigatus*, Longuemar, Études Géologiques et Agronomiques sur le Département de la Vienne, p. 487.
- 1871. *Nautilus lævigatus*, Phillips, Geology of Oxford and the Valley of the Thames, p. 441.

¹ Portlandien of d'Orbigny.

1872. *Nautilus sublævigatus*, Fritsch, Cephalopoden der böhmischen Kreideformation, p. 21, Taf. xii. f. 1.
1872. *Nautilus sublævigatus*, Geinitz, Palæontographica, Band xx. pt. ii., "Das Elbthalgelände in Sachsen, pt. ii.," p. 182, Taf. xxxii. ff. 1, 1 a, and 3.
1876. *Nautilus lævigatus*, Barrois, Mém. de la Société Géologique du Nord, vol. i. p. 107.
1879. *Nautilus lævigatus*, Ubaghs, Description Géologique et Paléontologique du Limbourg, p. 201.
1881. *Nautilus lævigatus*, Moulon, Géologie de la Belgique, vol. ii. p. 101.
- [Not 1846. *Nautilus lævigatus*, Forbes, Trans. Geol. Soc. ser. ii. vol. vii. p. 97.]

Sp. Char. "Shell globose, smooth, with the back and sides uniformly rounded, and a very faint line running along the middle of the back; umbilicus very small and entirely concealed in the inner whorls; septa slightly arched, with nearly straight margins; siphuncle a little in front of the centre; mouth nearly semicircular, but rather wider than high, deeply indented by the preceding whorl, with a broad, shallow, median sinus.

"*N. sublævigatus* is one of the commonest of the Cretaceous species, and is found throughout the whole range of the Chalk, viz. in the Upper Chalk near Brighton; in the Middle Chalk near Maidstone, Hemel Hempstead, and Tring; in the Grey Chalk at Dover and Lewes; in the Chloritic Marl of Bonchurch in the Isle of Wight; and in the Chalk with siliceous grains at Chardstock and on the coast of Dorsetshire." (*Sharpe*.)

Remarks. This species, like *N. plicatus*, is remarkably inflated; it is known only by casts, which exhibit no traces of shell-ornaments. The umbilicus is closed; the septa are rather distant; the siphuncle is nearly central, or a little above the centre. The typical locality of this species in England is Faringdon (or Farrington), Berkshire where it occurs in a coarse quartzose gravel, "mostly hardened by a ferruginous cement"¹. *N. sublævigatus* has been identified at various places on the Continent: in France (its typical locality), Holland, and Bohemia. Its identification, however, in the latter country is difficult, as the specimens are frequently crushed, and they have thus a compressed appearance, very different from the inflated form of the species in its normal condition. A variety of *sublævigatus* was described by Stoliczka² from the Cretaceous rocks of Southern India.

¹ See H. B. Woodward's 'Geology of England and Wales,' 2nd ed. 1887, p. 375.

² Mem. Geol. Surv. India—Palæont. Indica, 1866, pp. 203, 204, pl. v. ff. 1, 3.

The largest specimen in the Collection (No. 88592) is 9 inches in its greatest diameter and 8 inches in its greatest width.

The species nearest to the present one is the *N. Bouchardianus* of d'Orbigny, but the latter is distinguished by being umbilicated, and the surface-markings are much more distinct than in *N. sublaevigatus*.

Giebel¹, finding that the name *N. laevigatus* had been applied to a *Chymenia* by Münster, changed it to *N. cretaceus*, overlooking the fact that d'Orbigny² had already substituted the name *sublaevigatus* for *laevigatus*.

Horizon. Lower Greensand. Lower Chalk. Upper Chalk.

Localities. *British.* Faringdon, Berkshire (Lower Greensand), near Calne, Wiltshire (Chalk Marl); Pangbourn, Berkshire (Lower Chalk).—*Foreign.* Rouen, Seine Inférieure (Upper Greensand), Bourré, Loire-et-Cher; France (Lower Chalk); Maestricht, Belgium³ (Upper Chalk); Weisser Berg, Bohemia (Upper Cretaceous); Lemberg, Galicia (Chalk); Pondicherry, India (Cretaceous). The specimen from Pangbourn, Berks (No. 88965), was presented by the Hon. Robert Marsham.

Well represented in the Collection.

***Nautilus undulatus*, J. Sowerby.**

- 1813. *Nautilus undulatus*, J. Sowerby, Min. Conch. vol. i. p. 87, pl. xl. (upper figure).
- 1836. *Nautilus undulatus*, Fitton, Trans. Geol. Soc. ser. ii. vol. iv. pt. ii. pp. 129, 367.
- 1840. *Nautilus undulatus*, d'Orbigny, Paléontologie Française (Terrains Crétacés), vol. i. p. 93.
- 1845. *Nautilus undulatus*, Forbes, Quart. Journ. Geol. Soc. vol. i. p. 353.
- 1849. *Nautilus undulatus*, Quenstedt, Die Cephalopoden, p. 58.
- 1852. *Nautilus undulatus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 145.
- 1853. *Nautilus undulatus*, Sharpe, Description of the Fossil Remains of Mollusca found in the Chalk of England (Mon. Pal. Soc.), pt. i. Cephalopoda, p. 15, pl. v. ff. 4, a-c.
- 1854. *Nautilus undulatus*, Morris, Catalogue of British Fossils, 2nd ed. p. 307.
- 1854. *Nautilus Farringtonensis*, Sharpe, Quart. Journ. Geol. Soc. vol. x. p. 198, pl. vi. ff. 1 a, 1 b.

¹ Fauna der Vorwelt, Band iii. Abth. i. p. 149.

² Prodrome de Paléont. Stratigr. vol. ii. p. 189.

³ The specimen from this locality is of somewhat doubtful determination.

1854. *Nautilus Farringdonensis*, Morris, Catalogue of British Fossils, 2nd ed. p. 306.
1858. *Nautilus undulatus*, Ooster, Catalogue des Céphalopodes Fossiles des Alpes Suisses, pt. iii. p. 15.
1859. *Nautilus Farringdonensis*, Pictet et Campiche, Description des Fossiles du Terrain Crétacé des Environs de Sainte-Croix (Paleont. Suisse), sér. ii. pt. i. p. 123.
1862. *Nautilus undulatus*, Bristow and Etheridge, in Bristow's Geology of the Isle of Wight (Mem. Geol. Surv. of Great Britain, Sheet 10), p. 137.
1863. *Nautilus undulatus*, Schafhäütl, Süd-Bayerns Leth. Geogn. "Der Kressenberg und die südlich von ihm gelegenen Hochalpen" &c. p. 216, Taf. liii. f. 9.
1871. *Nautilus Faringdonensis*, Phillips, Geology of Oxford and the Valley of the Thames, p. 441.

Sp. Char. "Shell when young smooth and regular, with flattish sides, a broad rounded back, and semi-oval aperture; when about two inches in diameter it enlarges rapidly, expands at the sides, and begins to undulate over the back; when adult, the whole shell is ribbed in broad coarse undulations, which are deepest on the back, but ill-defined on the sides; back marked by a line at first slightly raised, which in the old shell forms a ridge between the undulations; umbilicus covered; septa flexuous; siphuncle near the ventral [inner] margin." (*Sharpe*.)

Remarks. Sowerby describes the septa of this species as being "somewhat numerous, each one . . . crossed obliquely by an undulation of the surface."

Sharpe observes that he only saw one specimen of this species from the Chalk; a young shell, $2\frac{1}{2}$ inches in diameter and $1\frac{1}{2}$ inch broad at the mouth." He adds:—"This shell is found more plentifully in the upper part of the Lower Greensand, where it reaches a diameter of 4 or 5 inches. . . . When young, *N. undulatus* has considerable resemblance to *N. Largilliertianus* [d'Orb.¹], from which it is distinguished by its closed umbilicus; in its undulated stage it cannot be confounded with any other species."

Though Sowerby's type is not in the British Museum, there is a specimen labelled "*Nautilus undulatus*, M. C. 182," in his handwriting, which is clearly identical with his species as described in the 'Mineral Conchology.'

Two specimens from the Lower Greensand of Hythe and Lympne in Kent, though badly preserved, show distinctly the strong undulations characteristic of this species, and the test exhibits also strong

¹ Pal. Franç., Terr. Crét. 1840, vol. i. p. 86, pl. xviii.

lines of growth. The Hythe specimen (No. 62160) is the largest in the Collection, and measures 8 inches in its greatest diameter. A specimen from the Neocomian of Neuchâtel, Switzerland, though a badly preserved cast, shows traces of the undulations, and may probably also be referred to the present species.

Nautilus Faringdonensis of Sharpe must be regarded as a synonym of the present species, the differences relied upon by Sharpe to separate his species from *Nautilus undulatus* being easily explained by the state of preservation of the former. The strong peripheral folds characteristic of *undulatus* are quite distinct upon a specimen from Faringdon in the British Museum. These folds being less prominent in Sharpe's specimen, may have led him to suppose that it had "fainter undulations than *N. undulatus*." Sharpe also claims for his species a larger umbilicus than Sowerby's: but on comparing several specimens of *undulatus* with the Faringdon fossil this alleged distinctive character also breaks down.

Schafhäütl figures a very imperfect specimen under the name *Nautilus undulatus*, but the reference seems very doubtful.

Horizon. Lower Greensand. Upper Greensand?

Localities. *British.* Hythe, Lympne, Kent; Faringdon, Berkshire; Devizes, Wiltshire.—*Foreign.* Eseragnolles, La Martre (Var); France (Lower Neocomian); Neuchâtel, Switzerland.

Of the other specimens contained in the Collection the localities are wanting, but they are doubtless British, and on the whole the species is very well represented.

***Nautilus plicatus*, Fitton.**

- 1802. *Nautilite brodé*, Montfort, in his edition of Sonnini's "Suite à Buffon" (Hist. Nat. des Mollusques, An. x.), vol. iv. p. 255, pl. xlviii. f. 2.
- 1835. *Nautilus plicatus*, Fitton, Trans. Geol. Soc. ser. ii. vol. iv. pt. ii. p. 129 (with woodcut), pp. 349 and 367.
- 1840. *Nautilus Requienianus*, d'Orbigny, Paléontologie Française (Terrains Crétacés), vol. i. p. 72, pl. x.
- 1841. *Nautilus plicatus*, Leymerie, Mém. Soc. Géol. de France, vol. iv. pt. ii. p. 342.
- 1841. *Nautilus Requienianus*, Leymerie, *ibid.* p. 342.
- 1842. *Merkwürdige Versteinerung*, Glocker, Nov. Acta Acad. Leop.-Carolin. Nat. Cur. vol. xix. pt. ii. p. 696, tab. lxix. ff. 1, 2.
- 1845. *Nautilus plicatus*, Forbes, Quart. Journ. Geol. Soc. vol. i. p. 353.
- 1847. *Nautilus Requienianus*, Pictet and Roux, Descriptions des Mollusques Fossiles des Grès Verts des Environs de Genève, p. 14.
- 1847. *Nautilus plicatus*, Pictet and Roux, *ibid.* p. 14.
- 1849. *Nautilus Requienianus*, Quenstedt, Die Cephalopoden, p. 58.

1849. *Nautilus plicatus*, d'Orbigny, Prodrôme de Paléontologie Française, vol. ii. p. 112.
1852. *Nautilus plicatus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 143.
1854. *Nautilus plicatus*, Morris, Catalogue of British Fossils, 2nd ed. p. 307.
1858. *Nautilus plicatus*, Ooster, Catalogue des Céphalopodes Fossiles des Alpes Suisses, pt. iii. p. 12.
1861. *Nautilus plicatus*, Reynés, Études sur le Synchronisme et la Délimitation des Terrains Crétacés du Sud-Est de la France, pp. 55, 89, 92.
1883. *Nautilus plicatus*, Leenhardt, Étude Géologique de la Région du Mont Ventoux, pp. 56, 71, 90.
1883. *Nautilus plicatus*, Uhlig, Die Cephalopodenfauna der Wernsdorfer Schichten (Denkschr. der k. Akad. der Wissensch.), Band xlv. p. 178, Taf. iii.

Sp. Char. Fitton's description of this species is limited to a very few words, which are accompanied by a woodcut, showing the characteristic sculpture of the species. He says "Some specimens 8 inches high, and 8 in diameter. The zigzag markings on the outside are very characteristic."

A further brief description of the species is given by James de Carle Sowerby¹ as follows:—"The Woodcut at p. 129 represents a portion of *Nautilus plicatus*, one third of the original size. The parallel linear furrows which pass over the whorls are bent three times at acute angles, once on each side and once in the middle, the central angle being directed backwards. There is often some irregularity in the junction of the lines at the angles."

Remarks. The most striking feature in this species is its rotundity, recalling, in this respect, the *N. perinflatus* of Foord and G. C. Crick, from the Inferior Oolite (see *ante*, p. 228). The whorls in section are more than double as wide as high, the septa somewhat approximate; the umbilicus is closed; the siphuncle is nearly central, or, if anything, a little above the centre. The sculpture has been well described by Dr. Fitton.

Giebel and Ooster make J. de C. Sowerby the author of this species, but though the latter added a more detailed description of it to Fitton's, yet Fitton not only bestowed the name but figured it and pointed out its characteristic sculpture. There can therefore be no question about Fitton being the author.

¹ Trans. Geol. Soc. ser. ii. vol. iv. 1835, pt. ii.; Dr. Fitton, "On the Strata below the Chalk," Appendix A, p. 349.

Glocker's figures of this species, though representing a crushed and distorted fragment, show very clearly the characteristic zigzag ornaments of the test.

D'Orbigny must surely have overlooked Fitton's excellent figure in the 'Transactions' of the Geological Society (*loc. cit.*), or he could not have failed to recognize the identity of Fitton's species with his own—*N. Requienianus*—which now falls into the synonymy of *N. plicatus*.

The largest example of the present species in the British Museum (No. 44463) measures about 1 foot in its greatest diameter and about 10 inches in its greatest width.

Horizon. Lower Greensand.

Locality. Atherfield, Isle of Wight.

Well represented in the Collection; one of the specimens (No. C. 991) was presented by J. E. Lee, Esq., F.S.A., F.G.S.

***Nautilus radiatus*, J. Sowerby.**

- 1822. *Nautilus radiatus*, J. Sowerby, Min. Conch. vol. iv. p. 78, pl. cclvi.
- 1836. *Nautilus radiatus*, Fitton, Trans. Geol. Soc. ser. ii. vol. iv. pt. ii. pp. 204, 367.
- 1838. *Nautilus radiatus*, d'Archiac, Mém. Soc. Géol. de France, vol. iii. p. 278.
- 1840. *Nautilus radiatus*, d'Orbigny, Paléontologie Française, Terr. Crét. vol. i. p. 81, pl. xiv.
- 1845. *Nautilus radiatus*, Ibbetson and Forbes, Quart. Journ. Geol. Soc. vol. i., table facing p. 197.
- 1845. *Nautilus radiatus*, Forbes, *ibid.* p. 353.
- 1849. *Nautilus subradiatus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 145.
- 1852. *Nautilus sgamosus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 141. (*Not of Schlotheim.*)
- 1854. *Nautilus radiatus*, Morris, Cat. British Fossils, 2nd ed. p. 307.
- 1859. *Nautilus Neckerianus*, Pictet and Campiche, Descr. des Fossiles du Terr. Crét. des Environs de Sainte-Croix, Paléont. Suisse, sér. ii. pt. i. p. 132, pl. xvi.
- 1862. *Nautilus radiatus*, Bristow and Etheridge, in Bristow's Geology of the Isle of Wight, Mem. Geol. Surv. of Great Britain, Sheet 10, p. 137.
- 1881. *Nautilus radiatus*?, Etheridge, in H. B. Woodward's Geology of the Country around Norwich, Mem. Geol. Surv. of Great Britain, p. 16.

1890. *Nautilus radiatus*, Foord and G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 398.

Sp. Char. "Shell somewhat compressed upon the sides, rounded upon the periphery; section of the whorls wider than high. Umbilicus closed, though open in the cast. Septa rather numerous, slightly curved upon the sides, a very obscure sinus upon the periphery. Siphuncle situated below the centre. Ornaments of the test consisting of numerous, very coarse, prominent, obtuse ridges, separated by interspaces of about half their own width. The ridges are each about 3 lines wide upon the periphery, where they form a narrow backwardly-directed sinus.

Remarks. "Pictet and Campiche, in the Pal. Suisse¹, have adopted the name *Nautilus Neckerianus* for a form which is evidently identical with Sowerby's *N. radiatus*, and the source of error seems to have been in the locality of the type specimen of the last-named species, which is referred to by Sowerby² in the following words:—'Lately found in the neighbourhood of Maltor, probably in the lower part of the Green Sand formation. I have received but one specimen, a cast in Marly Limestone, mixed with grains of Silex and of blackish Green-earth.' Possibly the locality quoted by Pictet and Campiche was taken from the Supplementary Index to the 'Mineral Conchology' by Mr. John Farey, who gives 'New-Malton, E.,' as the locality of the type.

"We have been able to identify Sowerby's type in the 'Sowerby Collection,' and the matrix agrees with that described by Sowerby, showing that the specimen came from the Lower Greensand. In its mode of preservation and general appearance as to colour, texture, &c., it closely resembles specimens from the Lower Greensand of Hythe. Without doubt Sowerby's specimen was derived from the Lower Greensand, but we have not been able to obtain any clue as to the locality (Maltor), furnished by him in his description, above quoted.

"There seems to be no ground whatever for Young and Bird's statement on p. 271 of their work on the Yorkshire Coast (2nd ed.), that 'Sowerby's *N. radiatus* (tab. 256) was found near Malton, most probably in the grey limestone under the Oolite.' Those authors were probably misled by the locality given by Farey in the Supplementary Index to vol. iv. of the 'Mineral Conchology.'

¹ Sér. ii. pt. i. 1859, p. 132, pl. xvi.

² Min. Conch. vol. iv. 1822, p. 78, pl. cccvi.

"*Nautilus bifurcatus*, Ooster¹, somewhat resembles the present species, but differs in its more compressed form, and in the possession of fine and numerous longitudinal ridges." (*Foord and G. C. Crick.*)

Horizon. Lower Greensand.

Localities. Atherfield, Isle of Wight; Hythe, Sandgate, Kent.

Well represented in the Collection.

***Nautilus Neocomiensis*, d'Orbigny.**

1768. *Un Nautilite*, &c., Knorr and Walch, Monumens des Catastrophes de la Terre, vol. ii. section i. p. 45, tab. i. fig. 2.
1813. *Nautilus squamosus*, Schlotheim, Taschenb. f. Mineralogie, vol. vii. p. 71.
1840. *Nautilus Neocomiensis*, d'Orbigny, Paléontologie Française (Terr. Crét.), vol. i. p. 74, pl. xi.
1841. *Nautilus Neocomiensis*, Duval-Jouve, Belemn. Terr. Crét. p. 10.
1842. *Nautilus Neocomiensis*, Matheron, Catalogue Méthodique et Descriptif des Fossiles du Département des Bouches-du-Rhône, p. 259.
1843. *Nautilus Neocomiensis*, Favre, Considérations sur le Mont Salève, p. 34.
1849. *Nautilus squamosus*, Quenstedt, Die Cephalopoden, p. 58.
1850. *Nautilus Neocomiensis*, d'Orbigny, Prodrôme de Paléontologie Stratigraphique, vol. ii. p. 63.
1850. *Nautilus Varusensis*, d'Orbigny, Prodrôme de Paléontologie Stratigraphique, vol. ii. p. 97.
1852. *Nautilus Neocomiensis*, Gras, Catalogue des Corps Organisés Fossiles du Département de l'Isère, p. 24.
1853. *Nautilus Neocomiensis*, de Verneuil et Collomb, Bull. Soc. Géol. de France, sér. ii. vol. x. p. 102.
1854. *Nautilus Neocomiensis*, Coquand, Mém. Soc. Géol. de France, sér. ii. vol. v. p. 147.
1854. *Nautilus Neocomiensis*, Morris, Cat. British Fossils, 2nd ed. p. 307.
1859. *Nautilus Neocomiensis*, Pictet et Campiche, Description des Fossiles des Environs de Sainte-Croix (Paléontologie Suisse, sér. ii. pt. i. livr. vii.), p. 128, pl. xv.
1860. *Nautilus Varusensis*, Pictet et Campiche, *ibid.* p. 123.
1861. *Nautilus Neocomiensis*, Reynés, Etudes sur le Synchronisme et la Délimitation des Terr.-Crétacés du Sud-Est de la France, p. 33.
1862. *Nautilus Neocomiensis*, Bristow and Etheridge, in Bristow's Geology of the Isle of Wight, Mem. Geol. Surv. Great Britain, Sheet 10, p. 137.

¹ Cat. des Céphalopodes Fossiles des Alpes Suisses, pt. iii. 1858, p. 10. tab. ix. f. 6, tab. x. ff. 1, 2.

1883. *Nautilus Neocomiensis*, Leenhardt, Étude Géologique de la Région du Mont Ventoux, p. 56.

1890. *Nautilus Neocomiensis*, Foord and G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 400.

[Not 1853. *Nautilus Neocomiensis*, Sharpe, Description of the Fossil Remains of Mollusca found in the Chalk of England, pt. i. Cephalopoda (Mon. Pal. Soc.), p. 15, pl. v. ff. 3, a-c.]

Sp. Char. "Shell compressed at the sides, with a narrowly rounded periphery. Umbilicus of moderate size, and exhibiting the inner volutions. Transverse section of the whorls wider than high. Septa very slightly curved upon the sides, and forming a slight sinus upon the periphery. Siphuncle placed a little below the centre. Ornaments of the test consisting of numerous, prominent, obtuse ridges, separated by interspaces about half their own width. These ridges are about 2 lines wide on the periphery, where they form a deep, narrow, backwardly-directed sinus.

Remarks. "This species differs from *N. radiatus* by its more compressed form and the much finer ornaments of the test. Moreover, *N. Neocomiensis* is stated by d'Orbigny to have been found only in the middle beds of the Neocomian, while *N. radiatus* was peculiar to the Craie glauconieuse ('Craie chloritée' of d'Orbigny and the older authors), none being found in the intermediate beds.

"*N. squamosus*, Lange (Schlotheim), and *N. Varusensis*, d'Orbigny, are placed in the synonymy of the present species on the authority of MM. Pictet and Campiche. Of the former those authors affirm that Quenstedt was quite in error in supposing it to be identical with the *Neocomiensis* of d'Orbigny, the *N. squamosus* of Lange being a smooth species from the Jurassic rocks of the neighbourhood of Baden. Of the latter (*N. Varusensis*) the same authors remark that the short description given of it by d'Orbigny indicates no appreciable difference between it and *Neocomiensis*." (Foord and G. C. Crick.)

A fine example of this species from the typical locality (Escragnolles) gives the following measurements:—greatest diameter about 7 inches; greatest breadth about $4\frac{1}{2}$ inches.

Horizon. Neocomian.

Localities. Grasse, Escragnolles (Var), France; Neuchâtel, High Alp (Sentis), Appenzell, Switzerland.

Well represented in the Collection.

***Nautilus Deslongchampsianus*, d'Orbigny.**

1822. *Nautilus elegans*, Mantell, Fossils of the South Downs, or Illustrations of the Geology of Sussex, p. 112, pl. xxi. f. 8.
1840. *Nautilus Deslongchampsianus*, d'Orbigny, Paléontologie Française (Terrains Crétacés), vol. i. p. 90, pl. xx.
1847. *Nautilus Deslongchampsianus*, Raulin, Mém. Soc. Géol. de France, sér. ii. vol. ii. p. 226.
1847. *Nautilus Deslongchampsianus*, Sismonda, Mem. Acad. Turin, sér. ii. vol. ix.
1850. *Nautilus Deslongchampsianus*, d'Orbigny, Prodrome de Paléontologie Stratigraphique, vol. ii. p. 145.
1852. *Nautilus Deslongchampsianus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 144.
1853. *Nautilus Deslongchampsianus*, Studer, Géologie der Schweiz, vol. ii. p. 291.
1853. *Nautilus Deslongchampsianus*, Sharpe, Description of the Fossil Remains of Mollusca found in the Chalk of England, pt. i. Cephalopoda (Mon. Pal. Soc.), p. 12, pl. iii. ff. 1 a, 1 b, 2.
1853. *Nautilus Neocomiensis*, Sharpe, *ibid.* p. 15, pl. v. ff. 3 a, 3 b, 3 c.
- ? 1853. *Nautilus radiatus*, Sharpe, *ibid.* p. 14, pl. v. ff. 1 a, 1 b, 2. (*Not* of J. Sowerby.)
1854. *Nautilus Deslongchampsianus*, Morris, Catalogue of British Fossils, 2nd ed. p. 306.
1858. *Nautilus Deslongchampsianus*, Ooster, Catalogue des Céphalopodes Fossiles des Alpes Suisses, pt. iii. p. 13.
1859. *Nautilus Deslongchampsianus*, Pictet et Campiche, Description des Fossiles du Terrain Crétacé des Environs de Sainte-Croix (Paléontologie Suisse), sér. ii. pt. i. pp. 122, 137.
1862. *Nautilus Deslongchampsianus*, Bristow and Etheridge, Mem. Geol. Surv. of Great Britain—Geology of the Isle of Wight (Sheet x.), p. 137.
1865. *Nautilus Deslongchampsianus*, Tate, Quart. Journ. Geol. Soc. vol. xxi. p. 28.
1871. *Nautilus Deslongchampsianus*, Phillips, Geology of Oxford and the Valley of the Thames, p. 441.
1881. *Nautilus Deslongchampsianus*, Etheridge, in Penning and Jukes-Browne's Geology of the Neighbourhood of Cambridge (Mem. Geol. Surv. of England and Wales), p. 137.

Sp. Char. "Shell subglobose, umbilicated, elegantly ornamented with sharp, elevated, transverse flexuous ribs, which are usually crossed by thin longitudinal lines; the latter obliterated in ill-preserved casts; the ribs rise within the umbilicus, and are bent at a sharp angle over its carinated margin; they then sweep forward in a bold curve, and form a deep sinus on the back [periphery], where they occasionally divide into two; the ribs are steep on their

front side and sloping behind, thus forming a series of steps on the surface; the edge of the umbilicus is angular or raised into a slight keel. The longitudinal ribs are very prominent in some specimens, but can hardly be discerned in others; but the species can always be distinguished by the form of the ribs, the deep and angular umbilicus." (*Sharpe*.)

Remarks. The sculpture, so well described by Sharpe, as well as its more inflated form, distinguishes this species from *N. expansus*, Sow., which it resembles in its angular umbilicus. From the other transversely ridged species, such as *N. elegans* and *N. radiatus*, it is distinguished also by its umbilicus, as well as by the longitudinal ridges which cross the transverse ones and impart a reticulated aspect to the surface of the test. The longitudinal ridges are only seen in tolerably well-preserved specimens, such as those numbered 83677 and C. 2249 in the Collection; there is no trace of them in most casts.

This species is very abundant in the Chalk Marl of England (Wiltshire especially), and it is also common in the Craie Chloritée of the neighbourhood of Rouen (Seine-Inférieure). It is easily recognized, even when crushed and distorted, by the sharply angular border of the umbilicus, as well as by its sculpture.

Sharpe figured a specimen of the present species (now in the British Museum, No. 88640) under the name *N. Neocomiensis*, and one of the specimens figured by Mantell as *N. elegans* proves also to belong to *N. Deslongchampsianus*.

Horizon. Upper Neocomian. Upper Greensand. Lower Chalk.

Localities. British. Warminster, Wiltshire; Sandroek Spring, Isle of Wight (Upper Greensand); Ventnor, Isle of Wight (Chloritic Marl); Niton, Isle of Wight (Lower Chalk); Cliffe Anstey, Devizes, Calne, Wiltshire; Sussex; Chard, Chardstock, Somersetshire (Chalk Marl); Lewes, Sussex (Grey Chalk).—*Foreign.* South of France (Upper Neocomian).

Well represented in the Collection, which contains the specimens figured by Sharpe and by Mantell. One of the specimens (C. 961) was presented by J. E. Lee, Esq., F.S.A., F.G.S.

***Nautilus pseudoelegans*, d'Orbigny.**

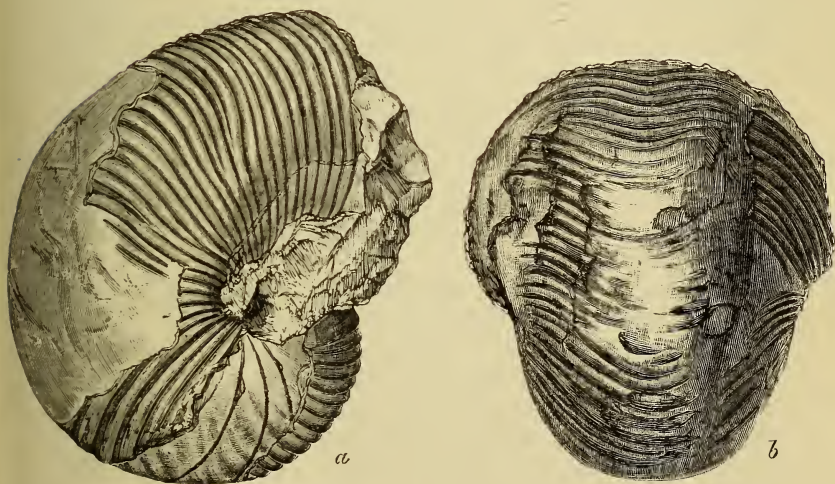
1835. *Nautilus globosus*, Potiez and Michaud (*vide* Gosselet, Études Paléontologiques sur le Département du Nord—Extrait des Mém. Soc. Imp. des Sciences, de Agriculture et des Arts de Lille, pp. 5, 11).

1840. *Nautilus pseudoelegans*, d'Orbigny, Paléontologie Française (Terrains Crétacés), vol. i. p. 70, pl. viii., pl. ix.

1841. *Nautilus pseudoelegans*, Leymerie, Mém. Soc. Géol. de France, vol. iv. pt. ii. pp. 336, 342.
1841. *Nautilus pseudoelegans*, Duval-Jouve, Bôlemn. Terr. Crét. p. 10.
1842. *Nautilus pseudoelegans*, Leymerie, Mém. Soc. Géol. de France, vol. v. pt. ii. p. 32.
1842. *Nautilus pseudoelegans*, Matheron, Catalogue Méth. et Descriptif des Fossiles du Département des Bouches-du-Rhône, p. 259.
1846. *Nautilus pseuodelegans*, Bruckmann, Leonhard & Bronn's Neues Jahrb. p. 717.
1850. *Nautilus pseudoelegans*, d'Orbigny, Prodrome de Paléontologie Stratigraphique, vol. ii. p. 63.
1851. *Nautilus pseudoelegans*, Cornuel, Bull. Soc. Géol. de France, sér. ii. vol. viii. pp. 434, 442.
1852. *Nautilus pseudoelegans*, Gris, Catalogue des Corps Organisés Fossiles du Département de l'Isère, p. 23.
1852. *Nautilus pseudoelegans*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 143.
1853. *Nautilus pseudoelegans*, Cotteau, Moll. Foss. de l'Yonne, p. 6.
1853. *Nautilus pseudoelegans*, Studer, Geologie der Schweiz, vol. ii. pp. 71, 280.
1853. *Nautilus pseudoelegans*, Sharpe, Description of the Fossil Remains of Mollusca found in the Chalk of England, pt. i. Cephalopoda (Mon. Pal. Soc.), p. 13, pl. iv. ff. 2 a, 2 b.
1854. *Nautilus pseudoelegans*, Morris, Catalogue of British Fossils, 2nd ed. p. 307.
1858. *Nautilus pseudoelegans*, Abich, Vergl. geol. Grundzüge der Kaukasischen, Armenischen und Nordpersischen Gebirge, p. 129.
1858. *Nautilus pseudoelegans*, Baily, Quart. Journ. Geol. Soc. vol. xiv. pp. 139, 156.
1858. *Nautilus pseudoelegans*, Pillet, Description Géologique des Environs d'Aix en Savoie, p. 33, pl. vi. f. 3.
1858. *Nautilus pseudoelegans*, Ooster, Catalogue des Céphalopodes Fossiles des Alpes Suisses, pt. iii. p. 11.
1859. *Nautilus pseudoelegans*, Pictet et Campiche, Description des Fossiles des Environs de Sainte-Croix (Paléontologie Suisse, sér. ii. pt. i. livr. vii.), p. 123, pl. xiv., pl. xiv. bis.
- ? 1861. *Nautilus pseudoelegans*, Blanford, p. 33, pl. xvii. f. 3, pl. xviii. ff. 3, 3 a, 3 b, pl. xix., pl. xx. ff. 1, 1 a.
1861. *Nautilus pseudoelegans*, Reynés, Études sur le Synchronisme et la Délimitation des Terrains Crétacés du Sud-Est de la France, pp. 31, 52, 55, 75, 89, 92.
1862. *Nautilus pseudoelegans*, Bristow and Etheridge, in Bristow's Geology of the Isle of Wight (Mem. Geol. Surv. Great Britain, Sheet 10), p. 137.
1862. *Nautilus pseudoelegans*, Ebray, Études Géologiques sur le Département de la Nièvre, fasc. 11, 12, p. 209.
- ? 1866. *Nautilus pseudoelegans*, Stoliczka, Mem. Geol. Surv. of India—

- Palæont. Indica—i. Cretaceous Cephalopoda of Southern India, p. 210, pl. xciii. f. 3.
1868. *Nautilus pseudoelegans*, Gosselet, Études Paléontologiques sur le Département du Nord (extrait des Mém. de la Société Imp. des Sciences, de l'Agriculture et des Arts de Lille), pp. 5, 11.
1871. *Nautilus pseudoelegans*, Phillips, Geology of Oxford and the Valley of the Thames, p. 441.
1873. *Nautilus pseudoelegans*, Falsan et Dumortier, Ann. Soc. Agric. Lyon—Note sur les Terrains du Bas-Bugey, p. 73.
1876. *Nautilus pseudoelegans*, Barrois, Recherches sur le Terrain Crétacé Supérieur de l'Angleterre et de l'Irlande (Mém. Soc. Géol. du Nord), vol. i. pp. 60, 81.
1877. *Nautilus pseudoelegans*, Price, On the Beds between the Gault and Upper Chalk near Folkestone, Quart. Journ. Geol. Soc. vol. xxxiii. p. 444.
1881. *Nautilus pseudoelegans*, Etheridge, in Penning and Jukes-Browne's Geology of the Neighbourhood of Cambridge (Mem. Geol. Surv. of Great Britain), Appendix A, p. 137.
1883. *Nautilus pseudoelegans*, Leenhardt, Étude Géologique de la Région du Mont Ventoux, p. 56.

Fig. 59.



Nautilus pseudoelegans.—*a*, lateral view, showing three of the septa, and the cast of the body-chamber, partly covered by the test; *b*, peripheral view, showing the curvature of the septa in the median line. Drawn from d'Orbigny's type, which forms part of the d'Orbigny Collection in the Museum of Natural History, Paris. About one third natural size.

Sp. Char. Shell much inflated, very broad, with somewhat

flattened sides and a very broadly rounded periphery, slightly flattened in the adult shell. Greatest width of the whorls about midway between the umbilicus and the median line of the periphery. Umbilicus small but distinct. Aperture very wide, semi-lunate, with rounded lateral margins. Septa approximate, very slightly sinuous on the sides of the shell, and forming an inconspicuous sinus on the periphery. Siphuncle situated below the centre of the septa. Test in the young shell very slightly striated transversely, but in the adult covered with very strong, regular, prominent, separate ribs or plications, which form a sigmoid curve on the sides of the shell, and rather a deep sinus on the periphery. The ribs bifurcate, and even trifurcate, in some places on the sides of the shell; the interspaces dividing them are about one half the width of the ribs themselves. The ribs mark the cast with very conspicuous plications; the former become flattened by weathering, but where well preserved they are seen to be distinctly rounded.

Remarks. This species was differentiated by d'Orbigny from *Nautilus elegans*, with which it had always been confounded; it is readily distinguished from that species by its much thicker and more robust form, closer septa, the position of its siphuncle, and the coarser character of its ornaments. It is also met with at a lower horizon, both in England and France, than Sowerby's species. From *N. Atlas* it differs in its broader periphery, open umbilicus, closer septa, and position of its siphuncle, which is near the inner margin of the septa, instead of the outer, as in *N. Atlas*. The ornamentation of the test is also much finer in the latter than it is in the present species. The *N. pseudoelegans* referred to by English geologists is probably that of Sharpe, which is shown below (p. 273) to be Sowerby's *N. elegans*.

According to MM. Pictet and Campiche¹ *N. pseudoelegans* presents some variations in the Sainte-Croix specimens, those authors distinguishing four distinct types, of which they give figures (plates xiv. & xiv. bis of the work cited above). The first of these types, which is from Yonne, is remarkable for the smoothness of the test in the young shell; the second, from Sainte-Croix, differs very little from the first, being only slightly more compressed. The third type scarcely differs at all from the two preceding ones. In the fourth some slight variations in the position of the siphuncle are noticed. It is suggested that the variations seen in the Sainte-Croix specimens, chiefly concerning the position of the siphuncle,

¹ Descrip. des Fossiles du Terr. Crét. des Environs de Sainte-Croix, Pal. Suisse, 1859, sér. ii. pt. i. pp. 123-128.

were brought about during the lengthened existence of this species in the Sainte-Croix region.

It is very apparent, judging from the figures of the Indian examples of the present species, figured by Blanford, that the ribs were much coarser in these than they are in the English specimens.

Comparing d'Orbigny's original specimen of *Nautilus pseudo-elegans*¹ with Blanford and Stoliczka's² figures and descriptions, I am inclined to doubt the identity of the Indian with the European form. The following is Blanford's description, which may be compared with that of the type specimen I have given above:—"Shell inflated, evenly rounded, ornamented with numerous sulcations generally visible on the cast. Ventral area broad and rounded. Umbilicus impressed and very small in the cast; the perforation not exceeding $\frac{1}{20}$ of the diameter of the shell. The sulcations rather variable in width, narrow on most specimens, forming a very obtuse angulation on the median ventral line, whence the sulci curve forward towards the umbilicus (generally becoming obsolete on the sides of the cast), and forming a very slight flexure towards the umbilicus. Aperture orbicular; septa numerous, about 22 to the whorl, the margins [sutures] slightly flexuous at the sides, straight or slightly convex in the ventral region." The siphuncle was subsequently to this description ascertained to be "rather approaching to the inner margin of the septa."³

The principal feature in which the Indian differs from the European form lies in the more narrowly rounded periphery, and altogether less robust habit of the shell, next in the smaller umbilicus, and, lastly, in the character of the ribbing, which seems to have been coarser in the Indian than it is in the French form. Blanford's fig. 2 (*loc. cit.* pl. xix.) certainly gives one the impression of being that of a much narrower shell than d'Orbigny's type. As all the specimens in the Indian Survey Collection are stated to be casts, it is not surprising that their characters (especially the ornaments of the test) should not have been very satisfactorily made out. On the whole I am inclined to regard the two forms as probably distinct, though perhaps rather nearly related.

D'Orbigny states that *Nautilus pseudo-elegans* is characteristic of

¹ For the loan of this and other specimens already mentioned I am indebted to the courtesy of Dr. Paul Fischer.

² Mem. Geol. Surv. of India—Palæont. Indica—i. Cretaceous Cephalopoda of Southern India, p. 33, pl. xvii. f. 3, pl. xviii. ff. 3, 3*a*, 3*b*, pl. xix., pl. xx. ff. 1, 1*a*.

³ Stoliczka, Mem. Geol. Surv. of India—Palæont. Indica—i. Cretaceous Cephalopoda of Southern India, p. 210, pl. xciii. f. 3.

the lower beds of the Neocomian, and that it was, at the time he wrote (1840), very abundant in the quarries in the neighbourhood of Vendevre (Aube). He records it also from Switzerland and the Crimea, and remarks that wherever it is found it is obtained from the Lower Neocomian beds.

There is a large cast in the Collection (No. C. 3168), measuring 1 foot 2 inches in its greatest diameter, and about 8 inches in width. It is from the Lower Greensand of Maidstone, and it presents so many characters in common with the present species that one is strongly inclined to assign it thereto. The septa are somewhat distant from each other, being about 2 inches apart on the sides of the shell; the sutures are slightly flexuous upon the sides and also upon the periphery. No trace of the test is preserved, the surface of the cast being much broken up. The very broad and robust form of the shell and its general appearance seem to justify its association with *Nautilus pseudoelegans*, and the horizon whence it was obtained strengthens this view of its affinities.

The few examples attributed to this species in the British Museum are, with the above exception, very much crushed, but their characters, so far as they can be made out, and the horizon from which the specimens were derived (Lower Greensand), warrant the conclusion I have come to, and in which Mr. G. C. Crick supports me, that they belong to d'Orbigny's species.

Horizon. Lower Greensand.

Localities. Maidstone, Sandgate, Kent.

Represented in the Collection by several examples, one of which (No. C. 1571) was presented by R. Etheridge, Esq., F.R.S.

***Nautilus Albensis*, d'Orbigny.**

- 1850. *Nautilus Albensis*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. ii. p. 122.
- 1854. *Nautilus Albensis*, Renevier, Perte-du-Rhône, p. 37.
- 1858. *Nautilus Albensis*, Ooster, Catalogue des Céphalopodes Fossiles des Alpes Suisses, pt. iii. p. 12.
- 1859. *Nautilus Albensis*, Pictet et Campiche, Description des Fossiles du Terrain Crétacé des Environs de Sainte-Croix (Paléontologie Suisse), sér. ii. pt. i. livr. vii. p. 134, pl. xvii.
- 1875. *Nautilus Albensis*, Jukes-Browne, "On the Relations of the Cambridge Gault and Greensand," Quart. Journ. Geol. Soc. vol. xxxi. p. 285.
- 1878. *Nautilus Albensis*, Barrois, Mém. sur le Terr. Crét. des Ardennes, Ann. de la Soc. Géol. du Nord, vol. v. p. 270.
- 1881. *Nautilus Albensis*, Etheridge, in Penning and Jukes-Browne's Geology of the Neighbourhood of Cambridge (Mem. Geol. Surv. of Great Britain), Appendix A, p. 151.

Sp. Char. "Species near to *N. Neckerianus*, Pictet, but distinguished by the siphuncle placed on the inner third of the whorls, and by a depression in the septum near the return of the spire." (*D'Orbigny*.)

Remarks. The depression mentioned by d'Orbigny is simply a median lobe in the sutures, and is of no specific importance whatever, as it is well known to occur in many species of *Nautilus*; d'Orbigny's description is, in fact, very inadequate, and were it not for his reference to *N. Neckerianus* (= *N. radiatus*), it would be impossible to identify his species. *N. Albensis* is thus described by Pictet and Campiche:—

"Shell slightly inflated in the young, but more so in the adult; the periphery (région externe) rounded. Umbilicus closed, and indicated by a simple depression when the test is present; infundibuliform and narrow in the cast. Aperture (Bouche) higher than wide, if the entire height be taken into consideration; its width in the median line is $\frac{2}{3}$ greater than its height. Septa rather sinuous, convex forwards in the outer third of the sides, and backwards in the inner third. A small depression [median lobe] is observed in the young shell, in the centre of the basal margin of the septa; but this depression does not persist, for it disappears in the adult. Siphuncle placed in the internal third of the septa. The ornaments consist of ridges which are strongly arched forwards, and form upon the periphery a backwardly directed sinus whose sides make an angle of about 120°. The ridges become narrower, and finally almost obsolete around the umbilicus; they disappear in the cast towards the middle of the sides, so that the surface in the middle of the shell is nearly smooth. The ridges are thick and somewhat wide apart, as not more than about ten, as a rule, or, at most, fifteen, can be counted in half the diameter of the shell along the median line of the periphery."

MM. Pictet and Campiche state further that it is impossible to affirm positively that their shell is the *N. Albensis* of d'Orbigny, the latter having been insufficiently described and not figured.

However this may be, the Gault of Folkstone yields abundantly a species which, on the whole, agrees very closely with Pictet and Campiche's description and figures of *N. Albensis*; but differs from it in respect that, up to a certain stage of growth, the test is smooth, the interval between the smooth and the ribbed part of the shell being usually occupied by incipient ribbing. The smooth part varies in extent in different individuals. The present species differs from *N. radiatus* (a Lower Greensand species) mainly in the imbricating character of the ribs, as well as in their greater coarseness; but the two species are evidently closely allied.

Owing to the crushed state of nearly all the adult specimens in their soft matrix (Gault Clay), it has been a matter of great difficulty to identify individuals of this species, which seems, moreover, to present several variations in the character of the ribbing. It was hopeless, however, to expect better material from such a deposit as the Gault, and therefore such decision has been come to with regard to the species identified as the facts seem to warrant.

There are many young individuals in the Collection which probably belong to this species, their characters agreeing with those of the younger portions of the adult shells mentioned above. At first sight it seemed as if some of these young shells might be referred to *N. Montmollini*, Pictet and Campiche¹, especially as they are characterized by having folds which are developed within the umbilicus and extend partly across the sides of the shell, but without reaching the periphery. The septa in these shells, however, are much closer together than they are represented in the figures of *N. Montmollini* given by Pictet and Campiche, and therefore it seems clear that they cannot belong to that species.

It may be mentioned that *N. Montmollini* is recorded in the English Gault by F. G. Hilton Price² and also by Jukes-Browne³; but both these authors place a note of interrogation after the name.

Mr. G. C. Crick concurs with me in the views here put forth regarding *N. Montmollini* and *N. Albensis*.

Unfortunately there are no French specimens in the British Museum belonging to either of these species, and this has added very much to the difficulty of identifying *N. Albensis*.

It is interesting to observe that Mr. J. F. Whiteaves has described a species from the Sucia Islands⁴ under the name of *Nautilus Suciensis*, which he regards as apparently "more closely allied to the *Nautilus Albensis* and *N. Neckerianus*, as described by Pictet and Campiche in the 'Paléontologie Suisse,' than to any of the ribbed Nautili from the Cretaceous rocks of North America."⁵

¹ Descrip. des Fossiles du Terrain Crétacé des Environs de Sainte-Croix (Paléontologie Suisse), sér. ii. pt. i. pp. 140, 147, pl. xviii. ff. 4-6.

² The Gault, 1879, p. 76.

³ "On the Relations of the Cambridge Gault and Greensand," Quart. Journ. Geol. Soc. 1875, vol. xxxi. p. 306; also in "Geology of the Neighbourhood of Cambridge" (Mem. Geol. Surv. England and Wales), 1881, Penning and Jukes-Browne, Appendix B, p. 151.

⁴ A group of small islands lying at the southern extremity of the Strait of Georgia (British Columbia), north of Orcas and San Juan Islands, but within United States territory.

⁵ Geol. Surv. of Canada, vol. i. pt. ii. ("On the Fossils of the Cretaceous Rocks of Vancouver and adjacent islands in the Strait of Georgia"), 1879, pp. 97-99, pl. xi. ff. 1, 1 a.

A very large specimen (No. C. 2049), having a maximum diameter of about 1 foot, may perhaps belong to this species; but it is too imperfect to be conclusively identified therewith. It is from the Gault of Otford, near Sevenoaks, Kent, and was presented to the British Museum by Charles Taylor, Esq.

Horizon. Gault. Cambridge Greensand. Red Chalk.

Localities. British. Near Folkstone, Kent (Gault); Hunstanton, Norfolk (Red Chalk); Cambridge (Cambridge Greensand).—*Foreign.* Escragnolles (Var), France.

Represented in the Collection by numerous specimens.

***Nautilus Bouchardianus*, d'Orbigny.**

- ‡ 1822. *Nautilus inequalis*, Mantell, The Fossils of the South Downs; or Illustrations of the Geology of Sussex, p. 83, pl. xxi. ff. 14, 15. (Not of J. Sowerby.)
- 1840. *Nautilus Bouchardianus*, d'Orbigny, Paléontologie Française (Terrains Crétacés), vol. i. p. 75, pl. xiii.
- 1846. *Nautilus lævigatus*, Forbes, Trans. Geol. Soc. ser. ii. vol. vii. p. 97.
- 1847. *Nautilus lævigatus*, d'Orbigny, Géologie du Voyage de l'Astrolabe, pl. vi. ff. 1, 2.
- 1850. *Nautilus Bouchardianus*, d'Orbigny, Prodrome de Paléontologie Stratigraphique, vol. ii. p. 122.
- 1850. *Nautilus Dekayi* (pars), d'Orbigny, Prodrome de Paléontologie Stratigraphique, vol. ii. p. 211.
- 1852. *Nautilus Bouchardianus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 148.
- 1853. *Nautilus Bouchardianus*, Studer, Geologie der Schweiz, vol. ii. p. 83.
- 1854. *Nautilus Bouchardianus*, Renevier, Perte-du-Rhône, p. 36.
- 1858. *Nautilus Bouchardianus*, Ooster, Catalogue des Céphalopodes Fossiles des Alpes Suisses, pt. iii. p. 12.
- 1859. *Nautilus Bouchardianus*, Pictet et Campiche, Description des Fossiles du Terrain Crétacé des Environs de Sainte-Croix (Paléontologie Suisse), sér. ii. pt. i. livr. vii. p. 142, pl. xviii. ff. 1–3. (? Not of d'Orbigny.)
- ‡ 1861. *Nautilus Bouchardianus*, Blanford, Mem. Geol. Surv. of India—Palæont. Indica—i. Cretaceous Cephalopoda of Southern India, p. 13, pls. iii., iv., v.
- ‡ 1866. *Nautilus Bouchardianus* (var.), Stoliczka, ibid. p. 203, pl. xcii. ff. 4, 4 a.
- 1874. *Nautilus Bouchardianus*, Price, Quart. Journ. Geol. Soc. vol. xxx. p. 363.
- 1878. *Nautilus Bouchardianus*, Barrois, Mém. sur le Terr. Crét. des Ardennes, Ann. de la Soc. Géol. du Nord, vol. v. p. 270.

1878. *Nautilus Bouchardianus*, Linth, Beiträge zur geol. Karte der Schweiz, Lief. xiii. p. 21.

? 1879. *Nautilus Bouchardianus*, H. B. Medlicott and W. T. Blanford, Manual of the Geology of India, pt. i. p. 284.

Sp. Char. Shell much inflated, especially in the adult, nearly as wide as high, smooth, with only a few lines of growth, and a little stronger in some places; strongly rounded on the periphery. Umbilicus open, generally very small, but sometimes a little wider. Septa moderately distant, slightly sinuous. Siphuncle small, situated a very little above the centre.

Remarks. Among the globular species of Cretaceous Nautili, the only one that can be strictly compared with *N. Bouchardianus* is *N. lævigatus*, which is, however, less inflated and has more distant septa than the first-named. *N. Clementinus* is distinguished from the present species by its more compressed form and by the position of its siphuncle.

Stoliczka¹ regards the Indian species of *Bouchardianus* (Blanford) as divisible into three species, viz. :—

1. *Nautilus Bouchardianus*, d'Orbigny, var.
2. *Nautilus sphaericus*, Forbes.
3. *Nautilus sublævigatus*, d'Orbigny, var.

The first (1) he regards as a variety of *N. Bouchardianus*, and observes that "the siphon is in one specimen [in the Indian Collections] distinctly external and in another internally subcentral. M. Pictet does not mention an internal position of the siphuncle in any of the European specimens. As, however, these specimens do not differ in any other characters from each other and from the true European Gault fossil, I retain them provisionally as varieties of *N. Bouchardianus*, d'Orb." Of the second species (2) he remarks that he has no doubt, from specimens in the Madras Museum, that it is the true *N. sphaericus* of Forbes, and he points out that the character distinguishing it from *N. Bouchardianus* consists in the "globosity (not the thickness) of the shell," as Forbes² correctly concluded in his description of the species. Upon the third species (3) Stoliczka observes that the specimens representing it (which were figured by Blanford³ under the name *N. Bouchardianus*) are

¹ Mem. Geol. Surv. of India—Palæont. Indica—i. Cretaceous Cephalopoda of Southern India, 1865, p. 203.

² Trans. Geol. Soc. 1846, ser. ii. vol. vii. p. 98.

³ Mem. Geol. Surv. of India—Palæont. Indica—i. Cret. Ceph. of Southern India, 1861, p. 13, pls. iii., iv., v.

“undistinguishable in most of the principal characters” from *N. sublaevigatus*, d’Orb.; and after remarking upon some slight differences, he concludes that the Indian forms are mere varieties of the French and English ones, with the latter of which they, however, agree best.

Stoliczka makes no mention of the septation of the Indian variety of *N. Bouchardianus*, though by this character it may be distinguished from *N. sphericus*, Forbes. and *N. Huxleyanus*, Blanford, both of which have wider septa than the form under discussion.

There seems much reason to doubt whether the form described and figured by Pictet and Campiche under the name *Bouchardianus* be the same as d’Orbigny’s; and that those authors themselves doubted the identity of the Swiss with the French species is apparent from the remarks they make upon it, observing upon the variations in the place of the siphuncle in the Swiss form, and adding, “There is perhaps in this an indication of a new species, but we have not been able to connect these modifications with any other physical character in the species: it is a point for consideration, but the material of the Sainte-Croix beds is insufficient to settle it.”

The specimen from Norlington, Sussex, figured by Mantell in his ‘Fossils of the South Downs’ under the name of *N. inequalis*, is too immature to pronounce any decided opinion upon, but it may belong to the present species. The character upon which Mantell founded his species, viz. the diminution of the septa in depth, as they approach the aperture, is one which cannot be regarded as of any specific importance, since it is common to all the Nautili. A large fragment (No. C. 576), in which a few septa and part of the body-chamber are preserved, may possibly belong to the present species. There are indications of fine and regular striations upon this specimen.

Horizon. Gault. Cambridge Greensand. Arialur Group of India (= Upper Chalk of England, Senonian of France).

Localities. British. Near Folkestone, Kent; Norlington, near Ringmer, Sussex (Gault); Cambridge (Cambridge Greensand).—*Foreign.* Escragnolles (Var), Perte-du-Rhône (Ain), France (Gault); Pondicherry, India (Arialur Group).

Fairly well represented in the Collection. One of the specimens of the Indian variety (No. 83624) was presented by the Hon. R. Marsham.

***Nautilus arcuatus*, Deshayes¹.**

1842. *Nautilus arcuatus* (*arqué*), Leymerie, Suite du Mém. sur le Terrain Crétacé du Département de l'Aube, pt. ii.²; Mém. Soc. Géol. de France, vol. v. pt. i. p. 14, pl. xviii. ff. 1 *a*, 1 *b*.
1846. *Nautilus arcuatus*, Leymerie, Statistique Géologique et Minéralogique du Département de l'Aube, p. 165.
1852. *Nautilus arcuatus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 182.
1859. *Nautilus arcuatus*, Pictet and Campiche, Descrip. des Fossiles du Terrain Crétacé des Environs de Sainte-Croix (Pal. Suisse), ser. ii. pt. i. p. 140.
1877. *Nautilus arcuatus*, Jukes-Browne, Supplementary Notes on the Fauna of the Cambridge Greensand, Quart. Journ. Geol. Soc. vol. xxxiii. p. 488.
1881. *Nautilus arcuatus*, Jukes-Browne, in Penning and Jukes-Browne, Geology of the Neighbourhood of Cambridge, Mem. Geol. Surv. England and Wales, Appendix B, p. 151.

Sp. Char. Shell inflated in the middle, and having a subangular periphery, with scarcely any umbilicus; septa as wide as high and very sinuous (très arquées); siphuncle situated a little below the centre. Test thin, and marked only with a few annulations and striae of growth, distinct only in the young shell.

Remarks. This species resembles *Nautilus Fleuriausianus*, d'Orb.; but the whorls of the latter are less embracing, the septa have not the same form, and the siphuncle is differently situated. The same differences separate the present species from *N. Clementinus*, d'Orb., which has besides a more rounded periphery.

Referring to the present species, Mr. Jukes-Browne (*loc. cit.*) remarks:—"Several casts agreeing in every respect with the figure and description of *N. arcuatus* have been found in the 'Nodule-bed,' though they are by no means common. They are easily distinguished from all others by the absence of any umbilicus, and by the pinched-up back; this character is very conspicuous in the inner whorl, but becomes gradually less in the later chambers." He adds:—"The species was found by Leymerie in the Gault of the

¹ I may take this opportunity of observing that Giebel (Fauna der Vorwelt, Bd. iii. Abth. i. p. 182) credits Leymerie with the authorship of this species; but the latter explains in the first part of his memoir that M. Deshayes determined a great part of the species already known, and separated from them the new species. The latter therefore have the name of Deshayes attached to them in M. Leymerie's descriptions.

² The first part of this memoir is contained in Mém. Soc. Géol. de France, 1841, vol. iv. pt. ii. p. 291.

Département de l'Aube; but I have not seen it quoted from any other locality."

Horizon. Gault. Cambridge Greensand.

Localities. Folkestone, Kent (Gault); Cambridge (Cambridge Greensand).

Well represented in the Collection.

***Nautilus Kayeanus* ?, Blanford.**

1861. *Nautilus Kayeanus*, Blanford, Mem. Geol. Surv. of India Palæont. Indica—i. Fossil Cephalopoda of the Cretaceous Rocks of Southern India, p. 31, pl. xvi. ff. 5, 6; pl. xvii. ff. 1, 2; pl. xviii. ff. 1, 2; pl. xxi. f. 2.

1866. *Nautilus Neocomiensis*, Stoliczka, *ibid.* p. 210. (*Not of d'Orbigny.*)

1879. *Nautilus Neocomiensis*, H. B. Medlicott and W. T. Blanford, A Manual of the Geology of India, pt. i. pp. 272, 274.

Sp. Char. "Shell discoid, compressed, ornamented with broad undulating ribs, forming an angle on the ventral axis, which is rather acute on the young shell and becomes somewhat more obtuse with age. The ribs do not appear to increase much in width with the growth of the shell, so that in a space equal to the semi-diameter, measured on the median ventral line of the shell, they are more numerous in adult than in young specimens; they are visible on the cast of adult specimens as regular sinuous undulations. Umbilicus perforated, but not exposing the inner whorls in the perfect shell. Ventral area evenly rounded, becoming flattened in the adult shell. Aperture ovate. Margins of septa moderately concave, slightly sinuous near the umbilicus, arcuated on the sides and straight or convex in the ventral region. Siphuncle large, excentric, dorsal, at about one-third the height of the septum.

"There is some difficulty in ascertaining the limits of this species and the amount of variation to which it is liable, owing to the bad state of preservation of most of the adult specimens. The large majority of these are argillaceous casts, the shell having entirely disappeared, or having been replaced by crystallized gypsum, which readily breaks off the cast, and being strongly attached to the matrix, rarely exhibits the external ornamentation of the original shell. The casts are further frequently crushed, and the shelly septa having disappeared, the position of the siphuncle cannot be determined, except in a single specimen.

"The size of the umbilicus in uncrushed specimens is tolerably constant, but the most striking character, and one by which this species may be readily recognized, is the number and approximation

of the septa, of which there are more than 24 in the whorl." (Blanford.)

Remarks. This species is said to be closely related to *Nautilus Negama*, Blanford (= *N. crebricostatus*, Blanf., according to Stoliczka), *N. pseudoelegans*, Blanford [non d'Orbigny], and *N. crebricostatus*, Blanford.

Stoliczka¹ identified the present species with *N. Neocomiensis*, d'Orb., after a comparison of actual specimens of the European with the Indian species, but there are not wanting characters which separate the two forms: thus, the ribs in *N. Kayeanus* are much coarser than those of *N. Neocomiensis*, and bend backwards almost at right angles to the sutures, in a manner very different to the ribs in the last-named species, in which their direction is more nearly in accordance with that of the sutures.

Horizon. Utatur² Group (= Chalk Marl and Upper Greensand of England, Cenomanian or Tourtia group of France).

Locality. Trichinopoly district, India.

Represented in the Collection by a specimen (No. C. 2606) which was presented to the British Museum by Dr. Wm. King, Director of the Geological Survey of India.

***Nautilus triangularis*, Monfort.**

1802. *Nautilite triangulaire*, Montfort, in his edition of Sonnini's "Suite à Buffon" (Hist. Nat. des Mollusques, An. x.), vol. iv. p. 292, pl. xlix. fig. 2.

1808. *Nautilus triangularis*, Montfort, Conch. Syst. p. 7 (*G. angulithes*).

1820. *Nautilites angulites*, Schlotheim, Die Petrefactenkunde, p. 84.

1832. *Nautilus triangularis*, Passy, Descr. Géol. de la Seine-Inférieure, p. 334.

1834. *Nautilus triangularis*, d'Archiac, Mém. Soc. Géol. de France, vol. ii. pt. ii. p. 191.

1840. *Nautilus triangularis*, d'Orbigny, Paléontologie Française, Terr. Crét. vol. i. p. 79, pl. xii.

1842. *Nautilus triangularis*, Matheron, Cat. Méth. et Descrip. des Fossiles du Départ. des Bouches-du-Rhône et Lieux Circonvoisins, p. 259.

1850. *Nautilus triangularis*, d'Orbigny, Prodrome de Paléontologie Stratigraphique, vol. ii. p. 145.

¹ Mem. Geol. Surv. India—Palæont. Indica—i. Cretaceous Cephalopoda of Southern India, 1866, p. 210.

² Formerly written Ootatoor. Utatur is a large village twenty miles north-north-east of Trichinopoly.

1852. *Nautilus triangularis*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 162.
1854. *Nautilus triangularis*, Millet, Paléont. de Maine-et-Loire, p. 103.
1859. *Nautilus triangularis*, Pictet et Campiche, Description des Fossiles du Terrain Crétacé des Environs de Sainte-Croix (Paléontologie Suisse), sér. ii. pt. i. pp. 141, 149.
1861. *Nautilus triangularis*, Reynés, Etudes sur le Synchronisme et la Délimitation des Terr.-Crétacés du Sud-Est de la France, p. 41.
1866. *Nautilus triangularis*, Beltremieux, Faune Fossile du Département de la Charente-Inférieure, pp. 43, 80.
1890. *Nautilus triangularis*, Foord and G. C. Crick, Ann. Mag. Nat. Hist. ser. 6, vol. v. p. 403.

Sp. Char. "Shell compressed, smooth, with the periphery alternately rounded and sharply angular; umbilicus closed; section triangular, the sides very slightly rounded, deeply emarginated by the preceding whorl. Septa considerably curved upon the sides, and projecting forwards upon the peripheral angle, slightly bent backwards in the umbilicus. According to d'Orbigny the siphuncle is situated below the centre, not far from the ventral border. Test unknown.

Remarks. "This species is readily distinguished from *Nautilus Fleuriausianus*, d'Orbigny, as figured and described in the Pal. Franç. (Terr. Crét. vol. i. p. 82, 1840, pl. xv.), by its sharply angular periphery at different stages of growth. D'Orbigny in his 'Prodrome' (vol. ii. 1850, p. 145) makes his *Nautilus Fleuriausianus* a synonym of the present species, but he gives no reason for so doing, and we have no evidence to show that *N. Fleuriausianus* underwent the same changes of form as those noticed in *N. triangularis*. These remarkable changes were pointed out by M. Ed. Guéranger in a paper read before the Geological Society of France (Bull. sér. ii. vol. vii. 1850, p. 803), and he thus described them:—"Un caractère particulier et inédit est d'avoir le dos de la spire alternativement anguleux ou en carène, et parfaitement arrondi;" . . . Stoliczka¹ considers also that these forms are quite distinct." (*Foord and G. C. Crick.*)

A remarkably fine specimen in the Collection (No. 32355) exhibits the transition from the angular to the narrowly rounded periphery very strikingly. This specimen is from the Upper Greensand of France.

Horizon. Lower Chalk (England). Upper Greensand (France).

Localities. British. Sidmouth, Devonshire; Folkestone, Kent.

Foreign. Escragnolles (Var), France.

Well represented in the Collection.

¹ Mem. Geol. Surv. India—Palæont. Indica—ser. ii. 1866, p. 207.

***Nautilus Fleuriausianus*, d'Orbigny.**

1840. *Nautilus Fleuriausianus*, d'Orbigny, Paléontologie Française (Terrains Crétacés), vol. i. p. 82, pl. xv.
- ? 1853. *Nautilus Fleuriausianus*, Sharpe, Description of the Fossil Remains of Mollusca found in the Chalk of England, pt. i. Cephalopoda, Mon. Pal. Soc. p. 16, pl. vi. ff. 3 a, 3 b.
1854. *Nautilus Fleuriausianus*, Morris, Catalogue of British Fossils, 2nd ed. p. 307.
1866. *Nautilus Fleuriausianus*, Stoliczka, Mem. Geol. Surv. of India—Palæont. Indica—i. Cretaceous Cephalopoda of Southern India, p. 206, pl. xciv. ff. 1, 1 a.
1876. *Nautilus Fleuriausianus*, Schlüter, Palæontographica, Band xxiv. Lief. ii. p. 169 (49), pl. xlv. ff. 3, 4.
- ? 1880. *Nautilus elegans*, Mourlon, Géologie de la Belgique, vol. i. p. 165.

Sp. Char. Shell compressed, with somewhat flattened sides and rounded periphery; umbilicus small; aperture higher than wide, deeply indented by the preceding whorl. Septa slightly flexuous on the sides, and very slightly emarginate on the periphery. Siphuncle below the centre. Casts smooth.

Remarks. The nearest species to this is the *Nautilus Sowerbyanus* of d'Orbigny, but the latter is a thicker shell with a more rounded periphery, larger umbilicus, and more sinuous septa.

It must be remarked that Sharpe's figure of *N. Fleuriausianus* differs somewhat from d'Orbigny's, as it represents a shell with a much broader periphery, and the sutures are also more flexuous, approaching in these characters the *N. Sowerbyanus* of d'Orbigny, which is, however, distinguished by its much smaller umbilicus. Sharpe has united *N. Fleuriausianus* and *N. Sowerbyanus* in spite of the differences just enumerated.

A fragment (No. 83228), alleged to be from Tournai, Belgium, but more probably from Mons, may be referred to this species. The body-chamber only is preserved; it is very compressed, with a narrowly rounded periphery at its base; the suture-line of the last septum can be made out, and it agrees essentially with the sutures of the present species.

Horizon. Upper Greensand.

Localities. *British.* Devizes, Wiltshire.—*Foreign.* ? Mons, Belgium.

Represented in the Collection by two examples.

***Nautilus Fittoni*, Sharpe.**

1836. *Nautilus compressus*, Fitton, Trans. Geol. Soc. ser. ii. vol. iv. pt. ii. pp. 203 & 367 (note).
 1853. *Nautilus Fittoni*, Sharpe, Description of the Fossil Remains of Mollusca found in the Chalk of England (Palæontographical Society), pt. i. Cephalopoda, Mon. Pal. Soc. p. 17, pl. vi. ff. 4, *a-c*.
 1854. *Nautilus Fittoni*, Morris, Catalogue of British Fossils, 2nd ed. p. 306.
 1862. *Nautilus Fittoni*, Bristow and Etheridge, Mem. Geol. Surv. of Great Britain—Geology of the Isle of Wight (Sheet x.), p. 137.
 1876. *Nautilus cf. Fittoni*, Schlüter, Palæontographica, Band xxiv. Lief. ii. p. 171 (51), Taf. xlvii. ff. 5, 6.

Sp. Char. "Shell discoidal, smooth; sides flat, sloping; back narrow and rounded, marked with a faint line along the middle; umbilicus large, allowing the inner whorls to be seen, its walls nearly perpendicular; aperture sagittate with the angles rounded off; septa with a very flexuous margin; siphuncle very near the lower margin of the whorls. Diameter about 3 inches, breadth 1 inch.

"This shell has a good deal of resemblance to *N. Saxbii* of Morris, in general form, proportions, and flexure of the septa; but differs from that species in its rounded back." (*Sharpe*).

Remarks. Sharpe observes that "this species was first noticed by Dr. Fitton in the Upper Greensand, Western Lines, Isle of Wight, and placed in the Museum of the Geological Society; it is called in his lists *N. compressus*, which name had unfortunately been previously applied to another species."

The *Nautilus compressus* of Sowerby, referred to by Sharpe, is now known as *Discites compressus*.

Schlüter's form, which, like Sharpe's original type, is only a fragment, agrees very well with the latter in its flattened shell and in the abrupt curvature of the sutures near the umbilicus.

With the present species two Indian forms have been compared, viz., *Nautilus angustus*, Blanford¹, and *Nautilus rota*, Blanford².

Horizon. Upper Greensand. Lower Chalk.

Localities. Warminster, Wiltshire (Upper Greensand); Lyme

¹ Mem. Geol. Surv. India—Palæont. Indica—"Fossil Cephalopoda of the Cretaceous Rocks of Southern India," 1861, p. 27, pl. xiv. ff. 1, 2. Ibid. 1866, p. 209.

² Mem. Geol. Surv. India—Palæont. Indica—"Fossil Cephalopoda of the Cretaceous Rocks of Southern India," 1861, p. 38, pl. xxiv. f. 3, pl. xxv. ff. 1, 2 (not f. 3). Ibid. 1866, p. 212.

Regis, Dorsetshire (Lower Chalk); Ventnor, Isle of Wight (Chloritic Marl).

Well represented in the Collection.

A specimen from Lyme Regis (No. 29) was presented by Sir H. De la Beche.

***Nautilus elegans*, J. Sowerby¹.**

1816. *Nautilus elegans*, J. Sowerby, Min. Conch. vol. ii. p. 33, pl. cxvi.
1822. *Nautilus elegans*, Mantell, The Fossils of the South Downs; or Illustrations of the Geology of Sussex, p. 112, pl. xx. f. 1 (not pl. xxi. ff. 1, 4, 8).
1826. *Nautilus elegans*, De la Beche, Trans. Geol. Soc. ser. ii. vol. ii. pt. i. p. 114.
1829. *Nautilus elegans*, Mantell, Trans. Geol. Soc. ser. ii. vol. iii. pt. i. p. 209.
1832. *Nautilus elegans*, Passy, Description de la Seine-Inférieure, p. 334.
1836. *Nautilus elegans*, Fitton, Trans. Geol. Soc. ser. ii. vol. iv. pp. 129, 152, 241, 367.
1836. *Nautilus elegans*, Picard, Bull. Soc. Géol. de France, vol. vii. p. 168.
1841. *Nautilus elegans*, Leymerie, Mém. Soc. Géol. de France, vol. iv. pt. ii. p. 299.
1842. *Nautilus elegans*, Leymerie, Mém. sur le Terr. Crétacé du Département de l'Aube, Mém. Soc. Géol. de France, vol. v. pt. i. p. 32.
1842. *Nautilus elegans*, Matheron, Catalogue Méth. et Descrip. des Fossiles du Départ. des Bouches-du-Rhône et Lieux Circonvoisins, p. 259.
1845. *Nautilus elegans*, Reuss, Die Versteinerungen der böhmischen Kreideformation, Abth. i. p. 21.
1849. *Nautilus elegans*, Quenstedt, Die Cephalopoden, p. 57, Taf. ii. f. 7 (reduced from Sowerby's figure in the Min. Conch. pl. cxvi.).
1851. *Nautilus elegans*, Mantell, Geological Excursion in the Isle of Wight, p. 186.
1852. *Nautilus elegans*, Geinitz, Das Quadersandsteingebirge oder Kreidegebirge in Deutschland, p. 110.
1852. *Nautilus elegans*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 142.
- ° 1852. *Nautilus elegans*, F. Roemer, Die Kreidebildungen von Texas, p. 37.
1853. *Nautilus elegans*, Sharpe, Description of the Fossil Remains of Mollusca found in the Chalk of England, Mon. Pal. Soc. p. 13, pl. iv. ff. 2 a, 2 b (not pl. iii. f. 3, nor pl. iv. f. 1).
1853. *Nautilus elegans*, Cotteau, Mollusques Fossiles de l'Yonne, p. 6.

¹ In the following table only those references in which the species is adequately described and figured could be verified.

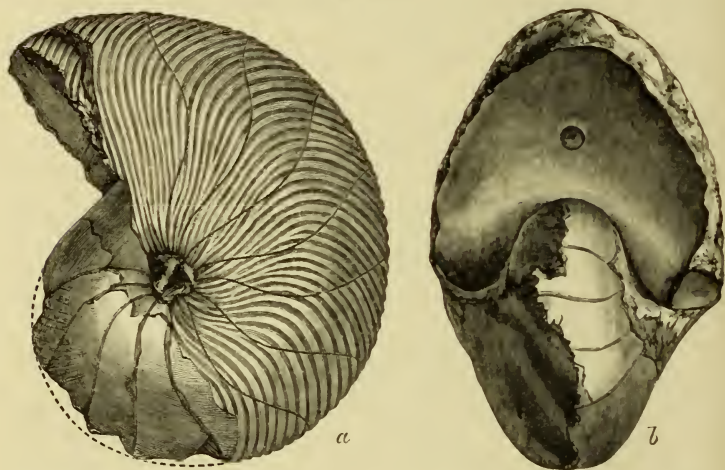
1854. *Nautilus elegans*, Morris, Catalogue of British Fossils, 2nd ed. p. 306.
1859. *Nautilus elegans*, Pictet et Campiche, Description des Fossiles du Terrain Crétacé des Environs de Sainte-Croix (Paléontologie Suisse), sér. ii. pt. i. p. 136.
1861. *Nautilus elegans*, Reynés, Études sur le Synchronisme et la Délimitation des Terr.-Crétacés du Sud-Est de la France, pp. 40, 57.
1862. *Nautilus elegans*, Bristow and Etheridge, Mem. Geol. Surv. of Great Britain—Geology of the Isle of Wight (Sheet x.), p. 137.
1862. *Nautilus elegans*, Ebray, Études Géologiques sur le Département de la Nièvre, fasc. 11, 12, p. 184.
1866. *Nautilus elegans*, Beltremieux, Faune Fossile du Département de la Charente-Inférieure, p. 80.
1868. *Nautilus elegans*, Dewalque, Prodrome d'une Description Géologique de la Belgique, p. 394.
1871. *Nautilus elegans*, Phillips, Geology of Oxford and the Valley of the Thames, p. 441.
- ? 1872. *Nautilus elegans*, Geinitz, Palæontographica, Band xx. pt. ii., "Das Elbthalgebirge in Sachsen," pt. ii. p. 181, Taf. xxxii. f. 6.
1872. *Nautilus elegans*, Fritsch, Cephalopoden der böhmischen Kreideformation, p. 20.
1876. *Nautilus elegans*, Whiteaves, Geol. Surv. of Canada, Mesozoic Fossils, vol. i. pt. i. p. 18.
1876. *Nautilus elegans*, Barrois, Recherches sur le Terrain Crétacé Supérieur de l'Angleterre et de l'Irlande (Mém. Soc. Géol. du Nord), p. 131.
1876. *Nautilus elegans*, Schlüter, Cephalopoden der oberen deutschen Kreide, Palæontographica, Band xxiv. Abth. ii. p. (134) 254.
1877. *Nautilus elegans*, Price, "On the Beds between the Gault and Upper Chalk near Folkestone," Quart. Journ. Geol. Soc. vol. xxxiii. p. 444.
1881. *Nautilus elegans*, Etheridge, in Penning and Jukes-Browne's "Geology of the Neighbourhood of Cambridge" (Mem. Geol. Surv. of Great Britain), Appendix A, p. 137.
- [Not 1840. *Nautilus elegans*, d'Orbigny, Paléontologie Française, Terrains Crét. vol. i. p. 87, pl. xix.—1850. *Nautilus elegans*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. ii. p. 145.—1853. *Nautilus elegans*, Sharpe, Descr. of the Foss. Remains of Mollusca found in the Chalk of England, pt. i. Ceph., Mon. Pal. Soc. p. 12, pl. iii. f. 3, pl. iv. f. 1.—1861. *Nautilus elegans*, Blanford, Mem. Geol. Surv. India—Palæont. Indica—i. Cretaceous Cephalopoda of Southern India, p. 29, pl. viii. f. 4, pl. xvi. ff. 1-4.—1866. *Nautilus elegans*, Stoliczka, Mem. Geol. Surv. India—Palæont. Indica—i. Cretaceous Cephalopoda of Southern India, p. 209.—1876. *Nautilus elegans*, Meek, Rep. United States Geol. Surv. Terr. vol. ix. p. 499, pl. viii. ff. 2 a-c.]

Sp. Char. "Gibbose, umbilicate, with numerous linear, reflexed, radiating sulci about two thirds as thick as wide; the septa

are rather numerous, gently waved; the aperture is obtusely sagittate, with the posterior angles truncated; umbilicus small, perhaps closed." (*J. Sowerby.*)

A more exact description of the species may be given as follows:—Shell inflated, somewhat flattened upon the sides, rather narrowly rounded upon the periphery; whorls deeply embracing. Umbilicus small. Septa moderately distant from each other, being $1\frac{1}{3}$ inches apart upon the periphery in the type specimen, where the height of the whorl, measured from the umbilicus, is about $4\frac{1}{4}$ inches. The sutures are bent backwards in a broad sinus on the

Fig. 60.



Nautilus elegans.—*a*, lateral view of a cast, showing the sutures and ribbing; the umbilicus is partly filled with the matrix; *b*, front view, showing the position of the siphuncle. Drawn from Sowerby's type specimen (No. 5671) contained in the British Museum. A little more than one third natural size.

sides of the shell, and are nearly straight on the periphery. Siphuncle about its own diameter below the centre. Ornaments of the test (type specimen) consisting of regular, transverse, prominent ribs (flattened in casts), separated by interspaces about half the width of the ribs, occasionally bifurcating, about seven of the ribs are contained in the space of an inch; they are curved sigmoidally on the sides of the shell, and form a deep sinus upon the periphery.

Remarks. The identity of this species has hitherto been completely mistaken, owing to the uncertainty existing as to the true character of Sowerby's fossil, the type of which had not been recognized.

There is in the Museum a specimen from Dr. Mantell's collection, bearing an old label in faded ink to the following effect :—" *Nautilus elegans*, Min. Con. pl. 116, . . . Chalk Marl. . . . Estate of Rev. J. Constable, Ringmer"¹.

On comparing this fossil with the figures of *Nautilus elegans* given by Sowerby² and Mantell³, no doubt can be entertained as to its identity with them. The figures have been restored to some extent, but not in such a way as to disguise altogether the characters of the fossil, otherwise its recognition would have been still more difficult. The foreshortening of the figure, a practice often indulged in by Sowerby, added not a little to the difficulty of realizing the form of the shell⁴.

An exact drawing of the fossil is here given (fig. 60), which is intended to supplement the deficiencies of Sowerby's figure and render the species more easily recognizable.

I may here add that I have had the advantage of seeing the specimen of *Nautilus elegans* figured by Sharpe under the name *N. pseudo-elegans* (Foss. Moll. of the Chalk, Mon. Pal. Soc. 1853, pt. i. Ceph. p. 13, pl. iv. f. 2). This fossil is now in the Museum of the Geological Society of London; there is no doubt whatever that it is identical with Sowerby's type of *N. elegans*, as Sharpe's figure, which is fairly accurate, had indeed led one to conclude.

Having thus cleared the ground as to what is really the *Nautilus elegans* of J. Sowerby, it will now be useful to notice, on the one hand, those species which, being in reality *N. elegans*, have had some other name erroneously applied to them, and, on the other hand, those species which have been wrongly named *N. elegans*. Sharpe has fallen into both these errors. His *Nautilus elegans*⁵ is not that of Sowerby, being a much wider and thicker shell, with closed umbilicus and the siphuncle above the centre. His *Nautilus pseudo-elegans*⁶, on the other hand, is not that species, but Sowerby's *elegans*. The source of this confusion is easily explained. Sharpe

¹ The locality given by Mantell ('Foss. South Downs,' p. 113) is "Middleham," but at p. 100 he states that "a low bank at Middleham, in the parish of Ringmer, near the seat of the Rev. J. Constable, contains *Hamites*, *Turritiles*, *Nautilites*, *Ammonites*, and *Inocerami*."

² Min. Conch. vol. ii. 1816, p. 33, pl. cxvi.

³ Fossils of the South Downs; or Illustrations of the Geology of Sussex, p. 112, pl. xx. f. 1 (not pl. xxi. ff. 1, 4, 8).

⁴ This has been a stumbling-block to many. F. B. Meek (United States Geol. Surv. Terr. vol. ix. 1876, p. 500, footnote) says :—"his [Sowerby's] single figure being an oblique view does not show the form of the aperture."

⁵ "Descr. of the Fossil Remains of Mollusca found in the Chalk of England" (Mon. Pal. Soc.), 1853, pt. i. Cephalopoda, p. 12, pl. iii. f. 3, pl. iv. f. 1.

⁶ Ibid. p. 13, pl. iv. ff. 2 a, 2 b.

has relied upon d'Orbigny's descriptions of the Chalk Nautili, in which the definition of *Nautilus elegans* departs so widely from Sowerby's, as to show that d'Orbigny's fossil ¹ was distinct from the latter.

Before noticing other authors who have described and figured the present species, or what they believed to be such, I desire here to record once more my great indebtedness to Dr. Paul Fischer, of the Museum of Natural History, Paris, who sent me the original specimen figured by d'Orbigny under the name *Nautilus elegans* (Pal. Franç., Terr. Crét. 1840, tom. i. p. 87, pl. xix.), thus enabling me to show the difference between the latter, as interpreted by d'Orbigny, and the true *Nautilus elegans* of Sowerby (see fig. 60, p. 272).

Along with the figured type of *Nautilus elegans*, d'Orbigny (= *N. Atlas*, Whiteaves), kindly lent to me by Dr. Fischer, is one which, though sent as an example of that species, differs materially from d'Orbigny's shell, its form being much more compressed, and the sutures closer together and more curved than those of the latter. These characters unite it with the true *N. elegans* of Sowerby, and it is interesting to find this species occurring in France. The French specimen is from the Cénomanien (Lower Chalk), as I am informed by Dr. Fischer.

Pictet and Campiche ² give no figures of *N. elegans*, but they recapitulate its characters (p. 117), saying, however, that its umbilicus is "très-grand," whereas Sowerby describes it as "small, perhaps closed." On the same page of their work these authors, referring to Mantell's figure of *N. elegans*, say that it probably represents a different species; but it is in truth a figure of the same specimen as that which formed the subject of Sowerby's figure in the 'Mineral Conchology,' and it was very probably copied from Sowerby's plate.

Turning to German authors, we find that Dr. Clemens Schlüter ³, in describing a new species of *Nautilus*, which he designates *N. Sharpei*, remarks upon the distinctness of the *Nautilus elegans* of d'Orbigny and Sharpe from the *N. elegans* of Sowerby.

Stoliczka ⁴ says of the Indian Cretaceous specimens, identified by Blanford as *Nautilus elegans*, that they "agree well with the Euro-

¹ D'Orbigny's *N. elegans* will now be known as *Nautilus Atlas*, a name proposed for it by J. F. Whiteaves (see *infra*, p. 292).

² Descr. des Foss. du Terr. Crét. des Environs de Sainte-Croix (Pal. Suisse), pt. i. 1859, pp. 117, 136.

³ Cephalopoden der oberen deutschen Kreide, Abth. ii., Palæontographica, 1876, Band xxiv. p. (51) 171, Taf. xlv. ff. 5-7.

⁴ Mem. Geol. Surv. India—Palæont. Indica—i. Cretaceous Cephalopoda of Southern India, 1866, p. 209.

pean [form], and the external position of the siphuncle can be often noticed on fragments in our collection." The "external position of the siphuncle" and the general form of the shell would associate the Indian species with d'Orbigny's, were it not that the ribbing in the latter appears to be finer, and the French form is, perhaps, on the whole, somewhat thicker than the Indian. As, however, there is only a single, badly preserved young example of the latter in the British Museum, I am not able at present to give a decided opinion upon the question whether d'Orbigny's fossil is or is not identical with Blanford's.

Two authors on the American continent, viz. Meek¹ and Whit-eaves², have made noteworthy observations on the present species.

Not satisfied with Sowerby's imperfect description and fore-shortened figure, Meek adopted with some hesitation Sharpe's interpretation of *Nautilus elegans*, which interpretation I have shown to be erroneous. Meek, in association with Hayden³, had already described the American fossil as *N. elegans*, var. *Nebrascensis*, but after reconsideration he gave up the varietal name on account of the resemblance of his form to the *N. elegans* of Sharpe, which he naturally supposed to be identical with Sowerby's species. He evidently, however, had his doubts about Sharpe's identification of the species in question being correct, for after describing the American form, he remarks that he believes the latter "will be found to agree so closely with Sowerby's species, that there may be no necessity for separating it, even as a variety—that is, if Mr. Sharpe's illustrations can be relied upon." He continues, "from Sowerby's application of the words 'indistinctly sagittate,' however, to the aperture, it would seem that his type specimen must be much more compressed than ours, which, as already stated, agrees well with Sharpe's figures in form. As Sharpe ought to have been well acquainted, however, with Sowerby's species, I infer that the latter's original type may have been *accidentally* compressed." It will be seen from this quotation that Meek was not quite satisfied in his mind of the identity of Sharpe's species with Sowerby's, and he singles out the discrepancies between these authors' descriptions with much discernment. He afterwards comments upon the retention by Pictet⁴, and also by Blanford⁵, of the name *Nautilus elegans*

¹ United States Geol. Surv. Terr. 1876, vol. ix. pp. 499–501.

² Geological Survey of Canada—Mesozoic Fossils, vol. i. pt. i. 1876, pp. 14–18

³ Proceed. Acad. Nat. Sci. Philadelphia, 1862, vol. xiv. p. 25.

⁴ Descr. des Foss. du Terr. Crét. des Environs de Sainte-Croix (Pal. Suisse), sér. ii. pt. i. 1859, p. 117.

⁵ Mem. Geol. Surv. India—Palæont. Indica—i. Cretaceous Cephalopoda of Southern India, 1861, p. 29. Ibid. 1866, p. 209.

for d'Orbigny's type; and remarks that "if *N. elegans*, d'Orbigny, is specifically distinct from the previously published *N. elegans*, Sowerby (which seems very probable), of course d'Orbigny's shell will have to receive some other name, as two species of the same genus cannot retain the same name." The required name has, as we have seen, been supplied by Mr. Whiteaves.

Judging by Meek's careful description and admirable figures of the American form, it appears to me to be distinct from *N. elegans*, Sowerby, as now redefined from the original specimen, and also from d'Orbigny's and Sharpe's *N. elegans*, which have been re-named *N. Atlas*. While admitting that Meek's form has undoubted affinities with the last-named species, I find that it differs in having a much wider shell, an open though small umbilicus, at least in the adult, and the siphuncle somewhat nearer the centre. On the whole, it is more like the Indian form already mentioned than the French form, *N. Atlas*.

Regarding Meek's form—*N. elegans*, var. *Nebrascensis*—Mr. Whiteaves¹ expresses the following opinion:—that "the description of the Nebraska fossil . . . accords much better with that of *N. Atlas* (nobis) than with Sowerby's diagnosis of his *N. elegans*. The globose shape, together with the position of the siphuncle in the American shell, are in favour of this view; but it is possible that the varietal name, proposed by Mr. Meek, may have to be raised to specific rank, as the sculpture of the so-called 'variety *Nebrascensis*' is said to consist of ribs which are 'five times as broad as the grooves between,' and in this respect it differs from *N. Atlas*, as well as from allied species."

It is due to Mr. Whiteaves to observe that he arrived at the conclusion, from a careful study of the descriptions of the species, that the *Nautilus elegans* of d'Orbigny and of Sharpe was distinct from the *N. elegans* of Sowerby, before he was aware that Pictet² had already pointed this out.

Upon the American species of Cretaceous Nautili, Mr. Whiteaves remarks:—"The few Nautili of the section Radiati, which have yet been described or quoted as occurring in the Cretaceous rocks of the United States, present curiously close affinities with European species."³

English specimens of *Nautilus elegans* are frequently in a crushed

¹ Geol. Surv. of Canada—Mesozoic Fossils, 1876, vol. i. pt. i. p. 18.

² Descr. des Foss. du Terr. Crét. des Environs de Sainte-Croix (Pal. Suisse), sér. ii. pt. i. 1859, p. 117.

³ Geol. Surv. of Canada—Mesozoic Fossils, 1876, vol. i. pt. i. p. 17.

and distorted condition, some of them being squeezed into less than half their natural thickness; this has contributed not a little to the difficulty which has been experienced in identifying the species. It is rarely that one finds a specimen with the symmetry of its form perfectly preserved; such is the case, however, with the specimen numbered C. 37 in the Collection, which is quite uncompressed, and shows the characters of the species admirably—sutures, siphuncle, &c. In no case is the outer layer of the test preserved, though the ornaments are very well displayed on most specimens.

Nautilus elegans is nearly allied to *N. pseudoelegans*, from which it is, however, easily distinguished by its much more compressed form and the finer character of the ribbing. From *N. Atlas* it differs in the first of these characters, and also in the position of its siphuncle.

The dimensions of the largest specimen in the Collection (No. C. 3360) are as follows:—Greatest diameter about 1 foot; greatest breadth about $6\frac{1}{2}$ inches.

The locality of this fine specimen, which is from the Lower Chalk, is unfortunately not recorded. A large specimen (cast) from the Upper Greensand of Ventnor, Isle of Wight, doubtless belongs to the present species, though the umbilicus is somewhat smaller than usual.

Horizon. Upper Greensand. Lower Chalk.

Localities. British. Folkestone, Kent; Ringmer (type specimen), Lewes, Sussex; Ventnor, Isle of Wight (Lower Chalk); Sussex; Cliffe Anstey, Wiltshire; Isle of Wight (Chalk Marl). There are also several large English specimens which are not localized.

Well represented in the Collection, which contains numerous very fine specimens, including Sowerby's type of the species (No. 5671) figured in the 'Mineral Conchology.'

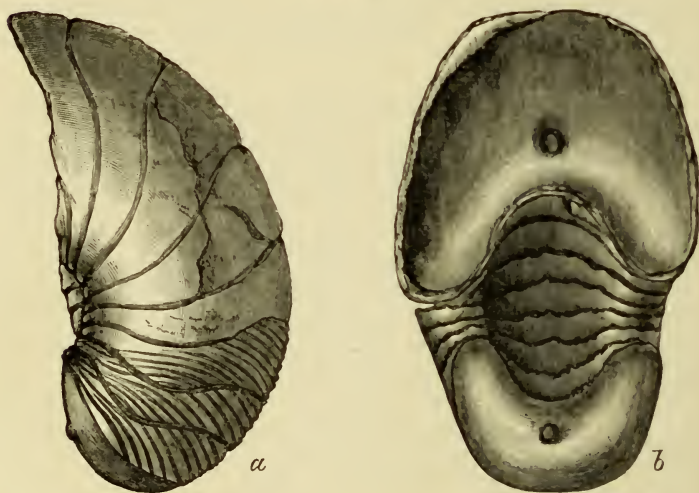
***Nautilus elegantoides*, d'Orbigny.**

1840. *Nautilus elegantoides*, d'Orbigny, Paléontologie Française, Terrains Crétacés, vol. i. p. 89.

Sp. Char. This species is briefly described by d'Orbigny (*loc. cit.*) in the following paragraph:—"Il paraît donc constant, d'après les observations des géologues et d'après mes observations personnelles, que le *Nautilus elegans* est spécial aux couches des craies tufau; car, tous les fragmens que j'ai recueillis dans le grès vert de la Normandie (Vaches noires), me portent à croire qu'il y existe encore une autre espèce voisine de l'*elegans*, mais bien plus étroite, et à siphon plus médian, que j'ai nommée *Nautilus elegantoides*, mais je ne la possède pas assez complète pour la caractériser nettement."

Remarks. As no mention is made of this species by d'Orbigny in his 'Prodrome' or elsewhere, it may be assumed that he never succeeded in obtaining such material as would have enabled him to describe the species completely. There is, however, a specimen in the British Museum (No. 37001) which possesses all the characters essential for the diagnosis of the species, which may thus be described:—Shell somewhat inflated, sides and periphery rather flattened, thus giving a squarish form to the whorls in section; widest part of the whorls in the umbilical region. Umbilicus open, of moderate size. Septa moderately distant; sutures considerably

Fig. 61.



Nautilus elegantoides.—*a*, lateral view of a very imperfect specimen, showing the form of the sutures; *b*, front view, showing the position of the siphuncle. Drawn from a specimen in the British Museum. One third natural size.

curved backwards on the sides of the shell and forming a conspicuous sinus on the periphery. Siphuncle considerably below the centre of the septa. Ornaments (seen only on the cast) consisting of strong, prominent, transverse ribs, which often separate into bundles of from two to four after leaving the umbilicus, so that in the latter situation they are much wider and coarser than in any other part of the shell. The interspaces dividing the ribs do not exceed one half the width of the latter. The ribs are only slightly

curved on the sides of the shell, but they form a conspicuous sinus on the periphery. The body-chamber is unknown.

This species most nearly resembles *Nautilus elegans*, J. Sow., but it differs therefrom in respect to its general form, which is more quadrate, viewed in section; moreover, the siphuncle is nearer the inner (dorsal) margin than in *N. elegans*, and the ribs are straighter on the sides of the shell and more frequently subdivided than they are in the last-named species.

Horizon. Grès Vert (Upper Greensand).

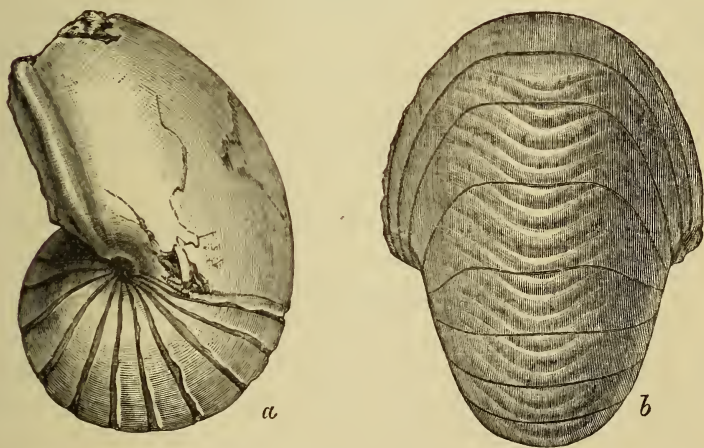
Locality. Honfleur (Calvados), France.

Represented in the Collection by a single example.

***Nautilus semiundatus*, Foord.**

Sp. Char. Shell (cast) inflated, especially in the young shell, very slightly compressed on the sides, broadly rounded on the periphery. Umbilicus closed; margin rounded. Greatest width of the

Fig. 62.



Nautilus semiundatus.—*a*, lateral view of a cast (No. 88590 *b*), showing nearly the whole of the body-chamber with the constriction near the margin of the aperture; *b*, peripheral view of another specimen (No. 37901), showing the coarse ribbing, limited to the peripheral area. The dark lines crossing the figure represent the sutures. Both figures are drawn from specimens in the British Museum; *a* is about one seventh, *b* a little over one fourth natural size.

shell in the umbilical region. Septa somewhat distant, being $1\frac{1}{2}$ inches apart in the median line of the periphery, near the body-

chamber, in a specimen (No. 88590 *b*) having a maximum diameter of 1 foot 3 inches. Sutures nearly straight on the sides of the shell, and slightly emarginate on the periphery. The siphuncle in a young individual (No. 36603), $1\frac{3}{4}$ inches in length, is very near the inner (dorsal) margin of the septa, where also there is a very conspicuous lobe in the sutures. Test unknown. Casts show that when the shell attained a diameter of 5 inches, strong V-shaped ribs were developed upon the periphery. These ribs are about 3 lines wide, with narrow interspaces, and are bent backwards at an angle of about 130 degrees. They cease to be visible when the shell has increased to a diameter of 7 inches; but on reaching what is probably the adult stage of growth, the cast exhibits on the body-chamber very faint indications of what may have been either fine ribs or coarse lines of growth. Length of the body-chamber rather less than half that of the last whorl; the aperture slightly constricted close to the edge.

In the cast (No. 37901, fig. 62 *b*) the ribs are about 3 lines wide, with narrow interspaces about half the width of the ribs (?).

Remarks. A species possessing somewhat similar sculpture is described by H. F. Blanford from the Cretaceous rocks of Southern India under the name of *Nautilus rota*. In this species the ribs "are generally more strongly marked on, and quite close to, the outer [peripheral] region, and also usually round the umbilicus"¹. *N. rota* may easily be distinguished from the present species by its more compressed form and strongly bent sutures².

Horizon. Upper Greensand.

Localities. Devizes, Wiltshire; Swanage, Dorsetshire.

***Nautilus ventroplicatus*, Foord.**

Sp. Char. Shell somewhat inflated, rather compressed on the sides, broadly rounded on the periphery. Umbilicus small, with rounded margin and rather steep sides. Greatest width of the shell in the umbilical region. Septa somewhat distant from each other; the sutures slightly curved on the sides of the shell. Ornaments consisting of strong rounded ribs developed only in the peripheral region, where they form a backwardly directed sinus. On a cast (No. 88590 *c*) in which part of the test is preserved, about three of the ribs, including the narrow interspaces, occupy a space of 5 lines.

¹ Mem. Geol. Surv. India—Pal. Indica—i. Cret. Ceph. of Southern India, 1861, p. 38, pl. xxiv. ff. 3, 3 *a*; pl. xxv. ff. 1, 1 *a*, 2 (not ff. 3, 3 *a*).

² Ibid. pl. xxv. f. 2.

The sides of the shell are smooth, excepting around the umbilicus, where prominent folds are developed. Siphuncle unknown.

Remarks. A fragment of the smooth part of the test on the sides of the shell, and a portion of the ribbing on the periphery, are well preserved on the cast above mentioned, which, together with another of about the same size, is derived from the Upper Greensand of Devizes. The present species may be distinguished from *Nautilus semiundatus*, its nearest ally, by its more compressed form, the finer character of its ribs, and its more flexuous sutures. *N. ventroplicatus* is represented in the Collection by two large badly preserved casts, on one of which, however, as already stated, fragments of the test remain, sufficient to display its characters. The dimensions of the largest specimen are as follows:—Greatest diameter $11\frac{1}{2}$ inches; greatest width about 8 inches.

Horizon. Upper Greensand.

Locality. Devizes, Wiltshire.

Represented in the Collection by two large examples.

***Nautilus Cenomanensis* ?, Schlüter.**

1876. *Nautilus Cenomanensis*, Schlüter, Cephalopoden der oberen deutschen Kreide, Palæontographica, Band xxiv. Abth. ii. p. 168 (48), Taf. xlv. ff. 1, 2.

Sp. Char. Shell somewhat compressed, both on the sides and on the periphery. Umbilicus open, but not wide. Septa rather approximate; sutures forming a sigmoidal curve upon the sides, and descending with an abrupt bend into the umbilicus; slightly emarginate on the periphery. Siphuncle situated between the centre and the inner margin of the septa. Surface of the cast in the young smooth; later, rather strong and regular ribs, similar to those of *Nautilus elegans*, are developed.

Remarks. The specimens which I have, with some hesitation, referred to this species, differ in one respect from Schlüter's form, viz., in the position of the siphuncle, which in the latter is described as being "between the centre and the inner side," whereas in the smaller of the British Museum examples (No. 24495) it is central.

This species is very nearly allied to *Nautilus elegans*, but it is distinguished therefrom by the flattening of the periphery; this may, however, be a character of only varietal importance. Unfortunately, in the larger of the two specimens (No. 36635) the siphuncle cannot be seen. This specimen measures about $9\frac{1}{2}$ inches in its greatest diameter, and about $5\frac{1}{2}$ inches in its greatest width. It is all septate.

Horizon. Upper Greensand.

Localities. Ventnor, Isle of Wight (No. 36635); Warminster, Wiltshire (No. 24495).

Represented in the Collection by two examples.

***Nautilus expansus*, J. de C. Sowerby.**

1822. *Nautilus elegans* (young state), Mantell, Fossils of the South Downs; or Illustrations of the Geology of Sussex, p. 113, pl. xxi. f. 4.
1824. *Nautilus expansus*, J. de C. Sowerby, Min. Conch. vol. v. p. 83, pl. cccclviii. f. 1.
1835. *Nautilus expansus*, Mantell, Trans. Geol. Soc. ser. ii. vol. iii. pt. i. p. 209.
1840. *Nautilus Archiacianus*, d'Orbigny, Paléontologie Française (Terrains Crétacés), p. 91, pl. xxi.
1840. *Nautilus expansus*, d'Orbigny, *ibid.* p. 93.
1850. *Nautilus Archiacianus*, d'Orbigny, Prodrome de Paléontologie Stratigraphique, vol. ii. p. 145.
1850. *Nautilus Archiacianus*, Dixon, The Geology and Fossils of the Tertiary and Cretaceous Formations of Sussex, p. 358, pl. xxix. f. 8.
1852. *Nautilus expansus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 148.
1852. *Nautilus Archiacianus*, Giebel, *ibid.* p. 161.
1853. *Nautilus expansus*, Sharpe, Description of the Fossil Remains of Mollusca found in the Chalk of England, pt. i. Cephalopoda, Mon. Pal. Soc. p. 11, pl. ii. ff. 3 a, 3 b, 4 a-c, 5.
1854. *Nautilus expansus*, Morris, Catalogue of British Fossils, 2nd ed. p. 306.
1858. *Nautilus expansus*, Ooster, Catalogue des Céphalopodes Fossiles des Alpes Suisses, pt. iii. p. 13.
1859. *Nautilus expansus*, Pictet et Campiche, Description des Fossiles du Terrain Crétacé des Environs de Sainte-Croix (Paléontologie Suisse), sér. ii. pt. i. p. 139.
1876. *Nautilus expansus*, Schlüter, Palæontographica, Band xxiv. p. 173 (53).

Sp. Char. "Shell globose, with sloping, slightly flattened sides and a sharply-defined umbilicus; surface elegantly marked by fine sharp lines of growth, which are deeply incurved in front; whorls increasing rapidly in size and nearly concealing the preceding whorls; septa very flexuous; siphuncle within the centre of the septum; mouth about as broad as high, somewhat pentangular, rounded in front, with nearly straight sloping sides deeply indented by the inner whorl, and with a deep, broad, rounded sinus. Diameter $2\frac{1}{4}$ inches, breadth $1\frac{1}{2}$ inch." (*Sharpe.*)

Remarks. Sharpe observes that "the figure in the 'Mineral Conchology' is taken from a specimen somewhat expanded at the mouth by pressure; but the form of the umbilicus and the fine sharp striæ leave no doubt of its identity with *N. Archiacianus*, d'Orbigny."

This species is very near to *N. Deslongchampsianus*, d'Orbigny, in its general form, and especially in the sharply angular border of the umbilicus, but the sculpture of the test serves at once to distinguish it. Whereas in *N. expansus* the test is marked only by fine striæ, in *N. Deslongchampsianus* there are strong transverse ribs, and between these a series of little continuous grooves running longitudinally, and forming crenulations in crossing the ribs. *N. expansus* is also flatter upon the periphery than *N. Deslongchampsianus*.

Horizon. Upper Greensand. Lower Chalk.

Localities. British. Warminster, Wiltshire (Upper Greensand): Ventnor, Isle of Wight; Sussex: Chardstock, Somersetshire (Lower Chalk): Ventnor (Chloritic Marl): Chard, Somersetshire; Wiltshire; Dover, Kent; Hamsey, Sussex—Sowerby's type (Chalk Marl).—*Foreign.* Rouen (Seine-Inférieure), France (Upper Greensand); Meglisalp (Sentis), Appenzell, Switzerland (Cretaceous).

Well represented in the Collection, which contains J. de C. Sowerby's type specimen (No. 43849), figured in the 'Mineral Conchology'; also the specimens figured in Mantell's 'Fossils of the South Downs,' and Dixon's 'Geology of Sussex.' One specimen (No. C. 2187) was presented by P. E. Combe, Esq.

***Nautilus Largilliertianus*, d'Orbigny.**

- 1840. *Nautilus Largilliertianus*, d'Orbigny, Paléontologie Française (Terrains Crétacés), vol. i. p. 86, pl. xviii.
- 1842. *Nautilus Largilliertianus*, Matheron, Cat. Méth. et Descrip. des Fossiles du Département du Bouches-du-Rhône et Lieux Circonvoisins, p. 259.
- 1850. *Nautilus Largilliertianus*, d'Orbigny, Prodrome de Paléontologie Stratigraphique, vol. ii. p. 145.
- 1852. *Nautilus Largilliertianus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 160.
- 1853. *Nautilus Largilliertianus*, Sharpe, Description of the Fossil Remains of Mollusca found in the Chalk of England, pt. i. Cephalopoda, Mon. Pal. Soc. p. 16, pl. vi. ff. 1 a, 1 b, 2 a, 2 b.
- 1854. *Nautilus Largilliertianus*, Morris, Catalogue of British Fossils, 2nd ed. p. 307.
- 1861. *Nautilus Largillierti*, Reynés, Études sur le Synchronisme et la Délimitation des Terr. Crétacés du Sud-Est de la France, p. 34.
- 1862. *Nautilus Largilliertianus*, Bristow and Etheridge, Mem. Geol. Surv. of Great Britain—Geology of the Isle of Wight (Sheet x.), p. 137.

1881. *Nautilus Largilliertianus*, Etheridge, in Penning and Jukes-Browne's Geology of the Neighbourhood of Cambridge (Mem. Geol. Surv. of Great Britain), Appendix A, p. 151.

Sp. Char. Shell compressed at the sides and flattened upon the periphery, the latter marked with a slightly raised median line ("normal line"). Section roughly quadrangular, much higher than wide, deeply emarginated by the preceding whorl. Umbilicus relatively large and exposing all the inner whorls. Surface of the shell provided only with a few lines of growth, which are not seen upon the cast. Septa moderately distant from each other, slightly flexuous upon the sides and in the umbilicus, nearly straight in passing over the periphery. Siphuncle very near the ventral (inner) margin.

Remarks. This shell is readily distinguished from the other Cretaceous species by the squarish form of the whorls, well-defined umbilicus, and position of the siphuncle. The lines of growth are only seen in well-preserved specimens.

N. Largilliertianus was found by d'Orbigny in the Craie Glauconieuse (=Craie Chloritée of Brongniart, d'Orbigny, &c.) of the hill of Sainte-Catherine at Rouen (Seine-Inférieure), associated with Ammonites and Turrilites; also in the lower beds of the Grès Vert at Cassis (Bouches-du-Rhône).

In England the present species is recorded by Sharpe as occurring occasionally in the Grey Chalk at Lewes, and in the Chloritic Marl of the Isle of Wight; and, more commonly, in the Chalk with siliceous grains of Chardstock and Chaldon.

Horizon. Upper Greensand. Cambridge Greensand. Lower Chalk.

Localities. British. Near Warminster, Wilts (Upper Greensand): Cambridge (Cambridge Greensand): Ventnor, Isle of Wight (Chloritic Marl): Sidmouth, Devonshire (Lower Chalk?).—*Foreign.* Rouen (Seine-Inférieure), France (Upper Greensand).

Well represented in the Collection. A specimen from Sidmouth, Devonshire, was presented by J. E. Lee, Esq., F.S.A., F.G.S.

[*Nautilus simplex*, J. Sowerby, Min. Conch. vol. ii. 1816, p. 47, pl. cxxii.—The type of this species cannot be found. It has been recorded by Morris, Fitton, Giebel, Mourlon, Ubaghs, and others, but whether correctly or not it is impossible to say. The only species from the Upper Greensand which can be fitly compared with *N. simplex* is one described in this volume under the name of *Nautilus semiundatus* (see *suprà*, p. 279). The latter, however, is ribbed upon the periphery, though not on the sides of the shell, whereas

Sowerby describes his species as "plain." Sowerby's specimen being a cast, may not have exhibited any distinct ribbing, which might nevertheless have been faintly visible, as is found to be the case in some weathered specimens. However this may be, the straight and rather widely separated sutures and the general form of the shell in *N. semiundatus* are features in which it resembles *N. simplex*, so far as may be judged from the figure and description of the latter. Unfortunately, the siphuncle has not been seen in *N. semiundatus*, and therefore it cannot be invoked in aid of this comparison. Its position in *N. simplex* is described as "nearest to the inner edge of the septum."]

Nautilus Clementinus, d'Orbigny.

1840. *Nautilus Clementinus*, d'Orbigny, Paléontologie Française (Terrains Crétacés), vol. i. p. 77, pl. xiii. bis.
- ? 1841. *Nautilus Clementinus*, Duval-Jouve, Belemn. des Terrains Crétacés, p. 9.
1842. *Nautilus Clementinus*, Leymerie, Mém. Soc. Géol. de France, vol. v. pt. i. p. 31.
1846. *Nautilus Clementinus*?, Forbes, Trans. Geol. Soc. ser. ii. vol. vii. p. 98.
1846. *Nautilus Clementinus*, Leymerie, Statistique Géologique et Minéralogique du Département de l'Aube, p. 165.
1850. *Nautilus Clementinus*, d'Orbigny, Prodrôme de Paléontologie Stratigraphique, vol. ii. p. 122.
1850. *Nautilus Indicus*, d'Orbigny, *ibid.* vol. ii. p. 211.
1852. *Nautilus Clementinus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 148.
1853. *Nautilus Clementinus*, Cotteau, Mollusques Fossiles de l'Yonne, p. 6.
1853. *Nautilus Clementinus*, Studer, Geologie der Schweiz, vol. ii. p. 83.
1854. *Nautilus Clementinus*, Morris, Catalogue of British Fossils, 2nd ed. p. 306.
1854. *Nautilus Clementinus*, Renevier, Perte-du-Rhône, p. 36.
1858. *Nautilus Clementinus*, Ooster, Catalogue des Céphalopodes Fossiles des Alpes Suisses, pt. iii. p. 13.
1859. *Nautilus Clementinus*, Pictet et Campiche, Description des Fossiles des Environs de Sainte-Croix (Paléontologie Suisse), sér. ii. pt. i. livr. vii. p. 144, pl. xix. ff. 1-5.
1861. *Nautilus Clementinus*, Reynés, Études sur la Synchronisme et la Délimitation des Terrains Crétacés du Sud-Est de la France, p. 40.
- ? 1861. *Nautilus Clementinus*, Blanford, Mem. Geol. Surv. India—Palæont. Indica—i. The Fossil Cephalopoda of the Cretaceous Rocks of Southern India, p. 17, pl. vi. pl. vii. ff. 1, 1 a, 2.

- ? 1866. *Nautilus Clementinus*, Stoliczka, *ibid.* p. 205.
 1874. *Nautilus Clementinus*, Price, *Quart. Journ. Geol. Soc.* vol. xxx.
 p. 363.
 1876. *Nautilus Clementinus*, Barrois, *Recherches sur le Terrain Crétacé Supérieur de l'Angleterre et d'Irlande*, p. 150.
 1878. *Nautilus Clementinus*, Barrois, *Mém. sur le Terr. Crét. des Ardennes*, *Ann. de la Soc. Géol. du Nord*, vol. v. pp. 270, 301.
 1878. *Nautilus Clementinus*, Linth, *Beiträge zur geol. Karte der Schweiz*, Lief. xiii. p. 21.
 ? 1879. *Nautilus Clementinus*, H. B. Medlicott and W. T. Blanford, *Manual of the Geology of India*, pt. i. p. 284.
 1881. *Nautilus Clementinus*, Etheridge, in Penning and Jukes-Browne's *Geology of the Neighbourhood of Cambridge* (*Mem. Geol. Surv. of Great Britain*), Appendix A, p. 151.

Sp. Char. Shell compressed-globose, marked in the young shell with fine striæ, both longitudinal and transverse, forming a regular network: when the shell becomes older these striæ are replaced by slight longitudinal lines; but these, at a still later stage of growth, completely disappear, the shell becoming quite smooth or marked only with faint lines of growth. The umbilicus is almost completely closed both in the young and in the adult shell. The aperture is higher than wide, a little flattened at the sides, but broadly rounded in front. The septa are moderately approximate, strongly bent forward in the region of the umbilicus, and nearly straight in passing over the periphery. There is a strong median (dorsal) lobe, which forms a very characteristic feature in the young of this species, and is best seen in detached septa; this lobe disappears in the adult shell. The siphuncle is placed a little below the centre, varying in position from the lower third to the lower fourth of the septa. The test is very thick and is often preserved.

Remarks. This species differs from *N. Bouchardianus*, which is met with in the same beds, in its more compressed form, and in the different position of the siphuncle. Pictet¹ compares *N. Clementinus* with *N. Montmollini*, Pict. et Camp., which, however, possesses an open umbilicus, much wider septa, and a siphuncle whose position is above, instead of below the centre.

Mr. Blanford² observes that "the Trichinopoly specimens [of *N. Clementinus*], which are not very numerous, exhibit nevertheless some variation in form, especially in the greater or less degree of flatness of the sides and ventral region." Similar variations have been noticed by MM. Pictet and Campiche in their works on the Cretaceous fossils of Sainte-Croix, already cited. Mr. Blanford

¹ *Loc. cit.* p. 146.

² *Loc. cit.* p. 18.

found that the *Nautilus* referred to the present species by Forbes belonged to another species which he describes under the name *N. Valudayurensis*¹.

Stoliczka, in his revision of the Nautilidæ described by Blanford², observes that "some of the specimens [of *N. Clementinus*] agree perfectly with the European fossils; others are, however, very much inflated, with a remarkably small umbilicus. Probably we have two species, but the materials are not sufficient to prove the correctness of this opinion."

For my own part I am very much disinclined to regard the Indian form of *N. Clementinus* as identical with the European one, which is a much more compressed shell than any of those figured by Blanford.

Horizon. Upper Greensand. Gault.

Localities. British. Near Folkestone, Kent; Norlington, near Ringmer, Sussex (Gault); Devizes, Wiltshire (Upper Greensand); Cambridge (Cambridge Greensand).—*Foreign.* Escragnolles (Var), Perte-du-Rhône (Ain), France (Gault).

Well represented in the Collection.

***Nautilus Cantabrigiensis*, Foord.**

1877. *Nautilus*, n. sp., Jukes-Browne, Supplementary Notes on the Fauna of the Cambridge Greensand, Quart. Journ. Geol. Soc. vol. xxxiii. p. 489.

Sp. Char. "Cast oblong, umbilicated; chambers few, only twelve being generally visible, and the last ones being as high as they are wide; the septa are consequently wide apart; sinuate and bent back near the umbilicus; siphuncle situated outside the centre and about one third of the distance from the outer edge³.

"This is the commonest form of *Nautilus* among the Cambridge coprolites⁴, but does not seem to agree with any previously described.

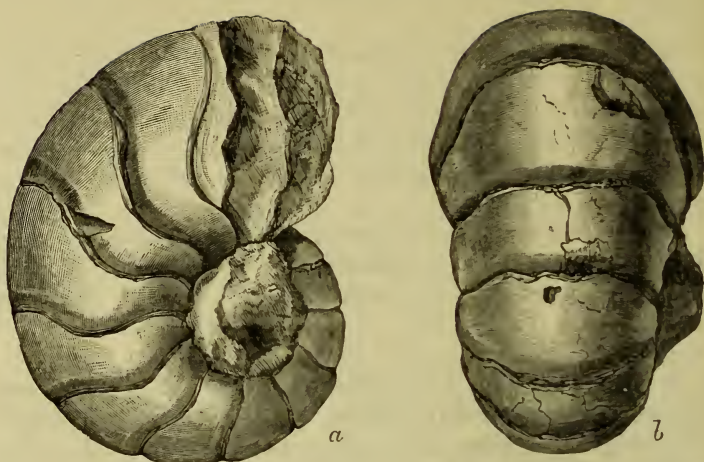
¹ Mem. Geol. Surv. of India—Palæont. Indica—i. Cretaceous Cephalopoda of Southern India, 1861, p. 23, pl. xii. figs. 2, 3.

² Ibid. 1865, p. 205.

³ The siphuncle is seen in two of the specimens in the British Museum, No. 68510 *a* and No. C. 874.

⁴ The following account of the Cambridge Greensand or "Coprolite Bed" is extracted from Penning and Jukes-Browne's "Geology of the Neighbourhood of Cambridge," 1881, p. 24 (Mem. Geol. Surv. England and Wales):—"This basement bed has long been known by the name of the 'Cambridge Greensand' or 'Coprolite Bed.' It is a clayey marl, to which a greenish colour and a sandy texture is imparted by the presence of numerous Glauconite grains,

Fig. 63.



Nautilus Cantabrigiensis.—*a*, lateral view of a cast (No. 68510), showing the curved sutures and the shelly plug filling the umbilicus; *b*, peripheral view of the same. Drawn from a specimen in the British Museum. Natural size.

Casts of the umbilicus seem to indicate that the shell had faint longitudinal striæ crossed by the lines of growth. . . .” (*Jukes-Browne*.)

Remarks. Many casts of this well-marked species are contained in the British Museum. *Nautilus Cantabrigiensis* is easily distinguished from *N. Clementinus*, d’Orb., which it most nearly resembles,

and its lowermost layer always contains an accumulation of the phosphatic nodules, commercially known as ‘coprolites.’

“The Cambridge Greensand has been traced north-eastwards from Harlington in Bedfordshire into Cambridgeshire, and has everywhere been found to present similar characters. Its constitution varies slightly in different places according as one or other of its several ingredients—clay, marl, or glauconite—happens to predominate, but everywhere the green grains become fewer and fewer in an upward direction, so that it gradually passes into the greyish beds of the Chalk Marl.

“For a long time it was considered as Upper Greensand, and was supposed to be the diminutive representative of the series of greensands, chert-beds, and firestones so well known in the south of England; it has been shown, however, that these die out in a northerly direction before the Cambridge Greensand commences, and it is much more probable that this is the homotaxial equivalent of the so-called Chloritic Marl, which is generally separated from the Upper Greensand by a band of phosphatic nodules.”

by the sinuous form of the septal sutures and their much greater distance apart, and by the position of the siphuncle, which in d'Orbigny's species is below the centre of the septa.

This species, so far as is known, is confined to the Cambridge Greensand.

Horizon. Cambridge Greensand.

Locality. Near Cambridge.

Well represented in the Collection.

[*Nautilus inæqualis*, J. Sowerby, Min. Conch. vol. i. 1813, p. 88, pl. xl. (lower figures).—This name was bestowed by Sowerby upon a young and imperfect individual alleged to have been derived from the Gault of Folkstone; but it has all the appearance of a Cambridge Greensand fossil. It is a cast of the septate part of the shell, and has a maximum diameter of barely $\frac{3}{4}$ of an inch. The umbilicus is very small, but it probably increased in size as the shell grew. Eleven septa are visible, the sutures of which are slightly arched on the sides of the shell, but nearly straight in passing over the broad and somewhat flattened periphery. The sutures have an inner (dorsal) lobe, which was mistaken by Sowerby for the siphuncle, which he says is "near the inner margin of the septum"; it is not, however, visible, and therefore this specific character (an important one, when so few are available) is wanting. Upon this meagre material was Sowerby's species based.

Mr. Jukes-Browne¹ questions the identity of the *Nautilus Clementinus* of Pictet and Campiche² with the *N. Clementinus* of d'Orbigny³; and remarks that both the figured forms appear to be represented among the Cambridge *Nautili*, the compressed forms agreeing with d'Orbigny's species and the more inflated ones with Pictet and Campiche's. Mr. Jukes-Browne thinks that the latter sufficiently agree with Sowerby's *N. inæqualis*. If this were correct, the *N. Clementinus* of Pictet and Campiche would become a synonym of *N. inæqualis* of Sowerby. I should hesitate, for my own part, to accept this arrangement without seeing examples of Pictet and Campiche's form. Though with abundant material before me, I find it impossible to determiné what maturer form, either of the

¹ "Supplementary Notes on the Fauna of the Cambridge Greensand," Quart. Journ. Geol. Soc. vol. xxxiii. 1877, p. 489.

² Description des Fossiles des Environs de Sainte-Croix (Paléont. Suisse), sér. ii., pt. i. p. 144, pl. xix. ff. 1-5.

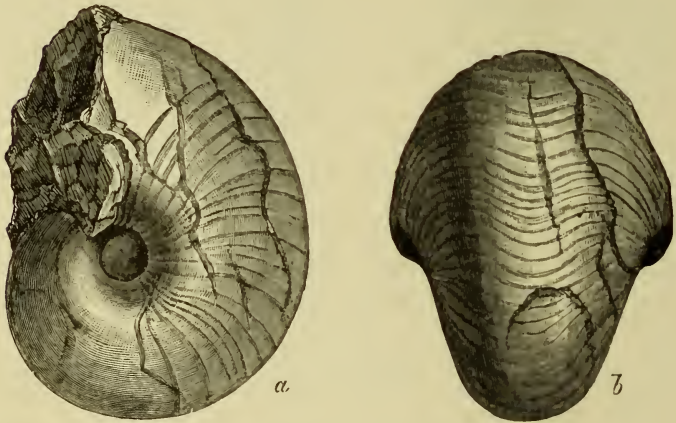
³ Paléontologie Française (Terrains Crétacés), vol. i. p. 77, pl. xiii. bis.

Gault or of the Cambridge Greensand, Sowerby's little shell belongs to; and on the whole I think it would be best, under the circumstances, to abandon the name *inequalis* altogether.]

***Nautilus Hunstantonensis*, Foord and G. C. Crick.**

1890. *Nautilus Hunstantonensis*, Foord and G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 401, ff. 4, 5.

Fig. 64.

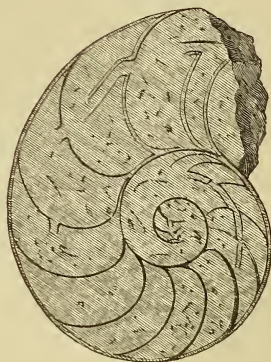


Nautilus Hunstantonensis.—*a*, lateral view, showing the open umbilicus; *b*, peripheral view, showing the lines of growth. Drawn from a specimen in the British Museum (No. C. 932), presented by J. E. Lee, Esq., F.G.S. About one half natural size.

Sp. Char. "Shell moderately inflated, slightly compressed on the sides, rounded on the periphery, widest part of the whorls in the umbilical region. Umbilicus small, deep, with steeply sloping sides and rounded edges. Septa rather wide apart, fourteen to a whorl in a specimen whose diameter is 3 inches (fig. 64). Siphuncle a little above the centre in the young shell, but getting much nearer the peripheral margin in the process of growth, as may be seen in the accompanying section (fig. 65), which is drawn (about three fifths nat. size) from a specimen in the British Museum (No. 82449). Surface of the test ornamented with obscure and irregular plications, commencing in the umbilicus, where they are most distinct, but becoming less so as they approach the periphery. Fine lines of growth cover the whole of the test.

Remarks. "There are two species in the Gault with which the present one may be compared, viz. *Nautilus Boucardianus*, d'Orbigny, and *N. Montmollini*, Pictet and Campiche. Our species agrees with the former of these in the position of its siphuncle, but differs in its more numerous septa and larger umbilicus, while it is distinguished from the latter chiefly by the position of its siphuncle, somewhat larger umbilicus, and more inflated whorls.

Fig. 65.



"The gradual shifting of the position of the siphuncle in the present species from a central position in the young to a nearly external position in the adult is a feature met with in other species; Stoliczka has observed it in *Nautilus Huxleyanus*, Blanford, and in *N. sphaericus*, Forbes, and other species¹.

"Many authors have recorded the occurrence of various species of *Nautilus* in the Red Chalk or Hunstanton Limestone²; but the present form does not appear yet to have been characterized." (*Foord and G. C. Crick.*)

Horizon. Red Chalk.

Locality. Hunstanton, Norfolk.

Well represented in the Collection.

¹ Mem. Geol. Surv. India—Palæont. Indica—ser. iii. 1866, p. 205.

² The following are some of the principal references:—

- (1) Samuel Woodward, 'An Outline of the Geology of Norfolk,' 1833, p. 54.—*Nautilus elegans*.
- (2) Rev. Thomas Wiltshire, "On the Red Chalk of England," Geol. Assoc. 1859, p. 17, pl. i. fig. 3.—*Nautilus simplex*.
- (3) H. G. Seeley, "Notice of Opinions on the Stratigraphical Position of the Red Limestone of Hunstanton," Ann. & Mag. Nat. Hist. ser. 3, vol. vii. 1861, p. 244.—*Nautilus simplex*.
- (4) Rev. T. Wiltshire, "On the Red Chalk of Hunstanton," Quart. Journ. Geol. Soc. vol. xxv. 1869, p. 184.—*Nautilus albensis*, *N. Boucardianus*.
- (5) W. Hill, "On the Lower Beds of the Upper Cretaceous Series in Lincolnshire and Yorkshire," Quart. Journ. Geol. Soc. vol. xlv. 1888, p. 347.—*Nautilus*, sp.

Nautilus Atlas, Whiteaves.

1840. *Nautilus elegans*, d'Orbigny, Paléontologie Française (Terrains Crétacés), vol. i. p. 87, pl. xix. (Not of J. Sowerby.)
1850. *Nautilus elegans*, d'Orbigny, Prodrome de Paléontologie Stratigraphique, vol. ii. p. 145. (Not of J. Sowerby.)
1853. *Nautilus elegans*, Sharpe, Description of the Fossil Remains of the Mollusca found in the Chalk of England, Mon. Pal. Soc. pt. i. Cephalopoda, p. 12, pl. iii. f. 3, pl. iv. f. 1. (Not of J. Sowerby.)
1876. *Nautilus Atlas*, Whiteaves, Geol. Surv. of Canada, Mesozoic Fossils, vol. i. pt. i. p. 17.

Sp. Char. Shell inflated, broadly rounded on the periphery, which makes a continuous arch with the sides and imparts a semilunate outline to the whorls when seen in section. The greatest breadth of the whorls is therefore a little above the umbilical region. Umbilicus closed. The septa are rather distant, being (type specimen) $1\frac{1}{3}$ inches apart where the height of the whorl, measured from the umbilicus to the median line of the periphery, is $3\frac{1}{2}$ inches. Siphuncle situated considerably above the centre of the septa. Test ornamented with rather strong, prominent, rounded ribs, separated from each other by interspaces equal to about half the diameter of the ribs. The latter make a broad forwardly-directed curve on the sides of the shell, and a broad and shallow sinus on the periphery. Owing to the lateral compression undergone by some specimens this sinus appears very deep in them, but in uncompressed specimens, of which there are a few in the Collection, the sinus is always shallow. The ribs leave their mark upon the cast in the form of faint plications.

Remarks. The above description is drawn up chiefly from d'Orbigny's figured type, but there is in the British Museum a fairly good example (No. C. 1027) from the same horizon and locality (Craie Chloritée, Rouen) as d'Orbigny's specimen. The Museum possesses also a good number of English specimens, a few of which are fairly well preserved (see Nos. C. 573, *a, b, c*, and 38683; one of these (No. C. 573) preserves its proper shape. They all exhibit the characteristic inflated form of the present species, by which it may be primarily distinguished from *N. elegans*, J. Sow., though to this feature must be added the closed umbilicus and the position of the siphuncle (approaching the peripheral border), all which characters separate it from Sowerby's species.

It may be observed that d'Orbigny's type specimen has had the matrix removed from the last exposed chamber since it was figured in the Pal. Franç. (pl. xix. ff. 1, 2), and the specimen now shows the position of the siphuncle.

Horizon. Lower Chalk.

Localities. *British.* Dover, Kent; Sussex; Ventnor, Isle of Wight; Cliffe Anstey, Calne, Wiltshire (Chalk Marl): Lewes, Newhaven, Sussex (Grey Chalk): Burham, Kent.—*Foreign.* Rouen (Calvados), France (Craie Chloritée).

Well represented in the Collection, which contains a great number of specimens, including an example from the typical locality of the species, viz. Rouen, presented by J. E. Lee, Esq., F.S.A., F.G.S.

***Nautilus Sowerbyanus*, d'Orbigny.**

- 1840. *Nautilus Sowerbyanus*, d'Orbigny, Paléontologie Française (Terrains Crétacés), vol. i. p. 83, pl. xvi.
- 1850. *Nautilus Sowerbyanus*, d'Orbigny, Prodrome de Paléontologie Stratigraphique, vol. ii. p. 189.
- 1852. *Nautilus Sowerbyanus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 150.
- 1858. *Nautilus Sowerbyanus*, Hauer, Beiträge zur Paläontographie von Oesterreich, Band i. Heft i. p. 14, Taf. i. ff. 1, 2.
- 1858. *Nautilus Sowerbyanus*, Ooster, Catalogue des Céphalopodes Fossiles des Alpes Suisses, pt. iii. p. 14.
- 1859. *Nautilus Sowerbyanus*, Pictet et Campiche, Description des Fossiles du Terrain Crétacé des Environs de Sainte-Croix (Paléontologie Suisse), sér. ii. pt. i. pp. 140, 149.
- 1870. *Nautilus Sowerbyanus*, de Longuemar, Études Géologiques et Agronomiques sur le Départ. de la Vienne, p. 487.

Sp. Char. Shell compressed on the sides, narrowly rounded on the periphery; umbilicus small, with rather steeply sloping sides. Aperture higher than wide; widest in the umbilical region. Body-chamber occupying about half a volution. Septa moderately distant from each other, about 16 to a whorl in a specimen whose greatest diameter is about $4\frac{1}{2}$ inches. Sutures slightly curved upon the sides of the shell and bent somewhat abruptly on approaching the umbilicus. Siphuncle about central¹. Casts quite smooth. Test unknown.

Remarks. This species most nearly resembles *Nautilus Fleuriauisianus*, d'Orbigny (p. 268), the differences between the two species having already been pointed out under the description of the latter.

Horizon. Lower Chalk.

Locality. Bourré (Loire-et-Cher), France.

Well represented in the Collection.

¹ The siphuncle is well shown in the specimen numbered 37271. Its position was unknown to d'Orbigny when he wrote his description.

Nautilus Huxleyanus, Blanford.

1861. *Nautilus Huxleyanus*, Blanford, Mem. Geol. Surv. India—Palæont.

Indica—Fossil Cephalopoda of the Cretaceous Rocks of Southern India, p. 19, pl. vii. ff. 3, 4; pl. viii. ff. 1, 1 a, 2, 3; pl. ix. ff. 1-4.

1866. *Nautilus Huxleyanus*, Stoliczka, *ibid.* p. 205.

1879. *Nautilus Huxleyanus*, H. B. Medlicott and W. T. Blanford, A Manual of the Geology of India, pt. i. p. 278.

Sp. Char. "Shell inflated, smooth, or striated minutely with lines of growth; in some specimens these become more strongly marked, and occasionally form ridges as in the specimen figured; umbilicus scarcely impressed, closed by the overlap of the outer whorl; ventral surface broad, evenly rounded, marked in some well-preserved casts with a fine filiform ridge. Aperture orbicular, moderate, and excavated by the interior whorl. . . . Septa very concave, with slightly flexuous margins, few and distant; from 13 to 16 in one whorl. Siphuncle at about $\frac{3}{4}$ the height of the septum. It is not unfrequently laterally excentric, viz. to the right or left of the median line." (*Blanford.*)

Remarks. Mr. Blanford further observes that the present species resembles "in general external form, as well as in the form of the septa, and in the external position of the siphuncle," *N. levigatus*, d'Orbigny, but that "certain minor characters are seen to be so prevalent [in a large series of specimens] as to stamp the present as a distinct species. These are: the great breadth of the chambers or, in other words, the small number of septa in the whorl, the greater excentricity of the siphuncle, and the tendency to form ribs or ridges of growth, manifested by some specimens, a tendency never seen in any specimens of *N. levigatus*."

Horizon. Trichinopoly Group (= Lower Chalk of England, Turoonian of France).

Locality. Garoodamungalum, Trichinopoly district, India.

Represented in the Collection by a single example (No. C. 2605), presented by Dr. Wm. King, Director of the Geological Survey of India.

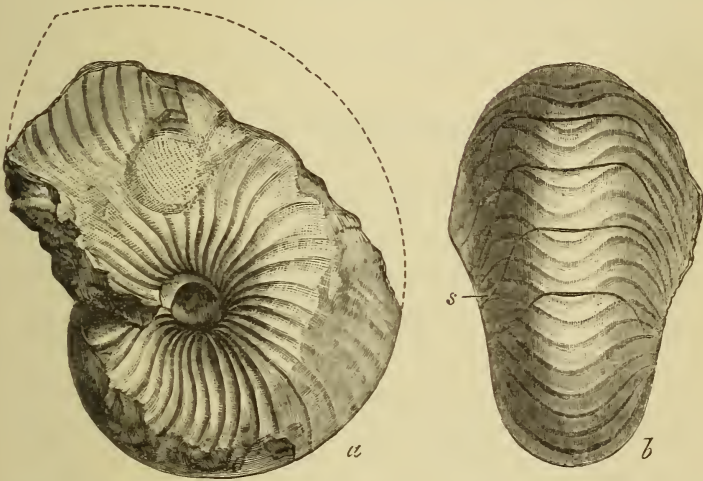
Nautilus Bayfieldi, Foord and G. C. Crick.

1890. *Nautilus Bayfieldi*, Foord and G. C. Crick, Ann. Mag. Nat. Hist. ser. 6, vol. v. p. 405, f. 7.

Sp. Char. "Shell somewhat compressed upon the sides and a little flattened upon the periphery, the thickest part of the whorls being in the umbilical region. The umbilicus is rather small, with

steeply sloping sides and rounded borders; the inner whorls partly exposed. The whorls present a subtriangular outline in section, owing to the flattening of the sides and the superior width of the dorsal as compared with the ventral or peripheral side. The septa are moderately distant, being about 7 lines apart where the height of the whorl is $1\frac{1}{3}$ inch. The sutures are slightly bent backwards on the sides of the shell, and form a shallow sinus on the periphery.

Fig. 66.



Nautilus Bayfieldi.—*a*, lateral view of a specimen, showing the umbilicus and the ribs ornamenting the test; *b*, peripheral view of another specimen, showing sutures (*s*) and ribs. Drawn from specimens in the British Museum (*a*, No. C. 3103; *b*, No. C. 3102), about two thirds natural size.

There appears to be an inner lobe. The siphuncle is situated a little below the centre. The test is ornamented with numerous acute transverse ribs or plications, separated from each other by spaces about equal to their own width. The ribs form a deep sinus in crossing the periphery.

Remarks. "This species is closely allied to *Nautilus patens*, Kner¹, from which, however, it differs in its more compressed whorls, smaller umbilicus, and the position of its siphuncle, which is below

¹ 'Versteinerungen des Kreidemergels von Lemberg und seiner Umgebung,' p. 7, tab. i. figs. 2, 2*a*. See also Dr. Clemens Schlüter, "Cephalopoden der oberen Deutschen Kreide," in Palæontographica, Band xxiv. Lief. 1, April 1876, p. 178, Taf. 1.

instead of being above the centre. The present species bears some resemblance to *Nautilus Deslongchampsianus*, d'Orb.¹; but the latter has a more inflated shell, a distinctly angular umbilical border, and longitudinal as well as transverse ornaments.

"We have pleasure in associating with this species the name of Mr. T. G. Bayfield, of Norwich, from whose fine collection of Upper-Chalk fossils all the examples of this species, now in the British Museum, were derived." (*Foord and G. C. Crick.*)

Horizon. Upper Chalk.

Locality. Norwich.

Well represented in the Collection.

***Nautilus vastus*, Kner.**

1850. *Nautilus vastus*, Kner, Verstein. des Kreidemergels von Lemberg und seiner Umgebung (Haidinger's Naturwiss. Abhandl. Band iii. Abth. ii.), p. 6, Taf. i. ff. 1, *a-c*.

1850. *Nautilus vastus*, Alth, Geognostisch-Paläontologische Beschreibung der nächsten Umgebung von Lemberg (Haid. Naturw. Abhandl. Band iii. Abth. ii.), p. 203.

? 1861. *Nautilus depressus*, Binkhorst, Monographie des Gastéropodes et des Céphalopodes de la Craie Supérieure du Limbourg, p. 12, tab. v. ff. 9, *a-c*. (Not *Nautilus depressus*, Bosc, in Détéville's ed. of Buffon, 1709 (?), Vers, pl. 42. f. 8, which is a *Bellerophon*.)

1876. *Nautilus cf. depressus*, Schlüter, Cephalopoden der oberen Deutschen Kreide, Paläontographica, Band xxiv. Abth. ii. p. 181.

Sp. Char. Shell much inflated; the periphery scarcely distinguishable from the sides, which form therewith an almost uninterrupted curve. The greatest width of the whorls is in the region of the umbilicus. The latter is closed or exceedingly small. The septa are rather widely separated, their distance apart being 1 inch on a fragment where the shell is $3\frac{1}{4}$ inches wide. The sutures are, as nearly as possible, straight upon the periphery, but slightly curved forwards at the junction of the latter with the sides of the shell; on the sides they form a very slight backwardly directed curve. The siphuncle is situated between the centre and the peripheral border.

Remarks. This species resembles *Nautilus Bouchardianus*, d'Or-

¹ Paléont. Française (Terr. Crét.), vol. i. p. 90, pl. xx.

² This species (*Nautilite déprimé*) is figured also in Sonnini's ed. of Buffon's Hist. Nat. des Mollusques (1798), edited by Denys-Montfort, vol. iv. p. 298, pl. iv. ff. 2, 3. See also Schlotheim, 'Die Petrefactenkunde,' 1820, p. 83.

bigny, in its general form, but it has a much wider shell, and the siphuncle is nearer the outer margin of the septa.

Horizon. Upper Chalk.

Locality. Maestricht (Limburg), Belgium.

Represented in the Collection by an imperfect specimen.

***Nautilus Heberti*, Binkhorst.**

1798. *Nautilité Silicieux*, Faujas de Saint-Fond, Histoire Naturelle de la Montagne de Saint-Pierre de Maestricht, p. 139, Atlas, pl. xxi. f. 1.

1859. *Nautilus DeKayi*, Binkhorst, Esquisse Géologique et Paléontologique des Couches Crétacées du Limbourg, pp. 8, 38, &c. (*Not of Morton.*)

1861. *Nautilus Heberti*, Binkhorst, Mon. des Gastéropodes et des Céphalopodes de la Craie Supérieur du Limbourg, p. 13, pl. v. b. ff. 1 a, 1 b.

1876. *Nautilus* cf. *Heberti*, Schlüter, Cephalopoden der oberen Deutschen Kreide, Abth. ii. (Palæontographica, Band xxiv.), p. 181 (61).

1879. *Nautilus Heberti*, Ubaghs, Descr. Géologique et Paléontologique du Limbourg, p. 201.

1881. *Nautilus Heberti*, Murlon, Géologie de la Belgique (Listes des Fossiles), vol. ii. p. 101.

Sp. Char. Shell inflated, periphery rather narrowly rounded, flowing uninterruptedly into the sides of the shell; greatest breadth in the umbilical region. Umbilicus exceedingly small. Septa rather numerous, the sutures strongly and abruptly bent back on the margin of the umbilicus, very slightly concave on the sides and nearly straight on the periphery. Siphuncle situated below the centre of the septa. Body-chamber probably very large. Test unknown. Casts quite smooth.

Remarks. The author of this species observes that he has only met with fragments of it, which are rare in the "craie jaune grossière" of Saint-Pierre and Fauquemont¹. Comparing the present species with *Nautilus Sowerbyanus*, its nearest ally, it is found to be much more inflated, especially on the sides, which are distinctly flattened in *N. Sowerbyanus*. The two forms, however, resemble each other in the narrowly rounded periphery and small umbilicus. It should be added that *N. Sowerbyanus* is from a much lower horizon (Chalk Marl) than *N. Heberti*.

The only specimen in the Collection (No. C. 3359) gives the

¹ Saint-Pierre and Fauquemont are both situated in the Province of Limbourg, Belgium.

following measurements:—Greatest diameter 10 inches; greatest breadth about 7 inches. It is completely silicified.

In the 'Prodr. de Paléont. Stratigr.' (vol. ii. 1850, p. 290) d'Orbigny described a species under the name of *Nautilus Hebertinus*, but the description has not been deemed sufficient by Favre¹ to establish the species. So far as it goes it agrees very well with Binkhorst's species. D'Orbigny's description runs thus:—"Grande espèce globuleuse, très-convexe, lisse, à ombilic très-étroit (dans le moule); cloisons peu arquées, non sinueuses, à siphon placé bien plus près du retour de la spire que du bord externe. France, Monttereau (Seine-et-Marne), la Falaise, Montainville, près de Beynes (Seine-et-Oise)."

Binkhorst seems to have overlooked d'Orbigny's species; he, at least, makes no mention of it. It is singular that he should have dedicated his species to the same individual, M. Hébert, as d'Orbigny had already done.

A very good, though foreshortened, figure of a *Nautilus*, which, judging by the position of the siphuncle &c., most probably belongs to the present species, was given by Faujas de Saint-Fond in the work quoted at the beginning of this description. Faujas's specimen, it will be observed, was in the same mineral condition as the specimen belonging to the British Museum, described above, and both are doubtless derived from the same beds.

Horizon. Upper Chalk.

Locality. Maastricht² (Limburg), Belgium.

***Nautilus sphæricus*, Forbes.**

1846. *Nautilus sphæricus*, Forbes, Trans. Geol. Soc. ser. ii. vol. vii. pt. iii. p. 98 (outline figure).

1861. *Nautilus Bouchardianus* (pars), Blanford, Mem. Geol. Surv. India—Palæont. Indica—i. Cret. Ceph. of Southern India, p. 13.

1866. *Nautilus sphericus*, Stoliczka, *ibid.* p. 203, pl. xcii. ff. 3, 3 a.

1877. *Nautilus sphæricus*, Meek, Report United States Geol. Surv. of the Territories, vol. ix. Invert. Cretaceous and Tertiary Fossils of the Upper Missouri, p. 497.

1879. *Nautilus sphericus*, H. B. Medlicott and W. T. Blanford, Manual of the Geology of India, pt. i. p. 284.

Sp. Char. "A very globose shell, as broad as long. It is distinctly umbilicated. The chambers are narrow, and the septa are

¹ Descrip. des Mollusques Fossiles de la Craie des Environs de Lemberg en Galicie, 1869, p. 8.

² Sometimes written Maastricht.

slightly curved towards the umbilicus. The siphon is ventrally [dorsally] excentric. The mouth is lunate and narrow. The surface of the shell appears to have been smooth. *Nautilus Bouchardianus*, described and figured by d'Orbigny from the French Gault, resembles the Indian species, but is not so globose, and the siphon is differently placed." (*Forbes*.)

Remarks. The umbilicus in this species has a somewhat angular margin; the siphuncle is distinctly below the centre. The surface of the test, though essentially smooth, is marked with fine lines of growth. Describing the difference between the present species and *N. Bouchardianus*, Stoliczka remarks:—"The section [in *N. sphaericus*] being usually twice as broad as high, has the greatest thickness at about half the height and not near the centre. The umbilicus is in itself narrow, but perforated through and has all round a broad funnel-shaped depression, on the edge of which the shell attains its greatest thickness, and then forms a uniform curve to the other side, leaving in this way a very broad outer region. Some specimens are laterally somewhat flattened, and therefore in section not so broad as compared with the height. This flatness is, however, perfectly different from that of *N. Bouchardianus*, being only strictly lateral round the umbilicus to a little distance, and does not in the least influence the broadness of the outer region, while in the last-quoted species the flatness extends to the outer region and causes its [comparative] narrowness. The two species have therefore perfectly distinct characters and may be readily recognized."

Horizon. Arialur Group¹ (= Upper Chalk of England, Senonian of France).

¹ This group is the highest of the South Indian Cretaceous series, the name being derived from the town of Arialur, in the Trichinopoly district. "The invertebrate fauna of the Arialur group exceeds in richness even that of the Utatur beds, no less than 365 species having been detected in the uppermost subdivision of the Cretaceous rocks of Southern India. The Cephalopoda comprise 36 species, Gasteropoda 138, Lamellibranchiata 117, Brachiopoda 12, Bryozoa 23, Echinodermata 26, Anthozoa 10, Foraminifera 1, and Vermes 2. It is highly probable that this large number may be due partly to the circumstance that the Arialur deposits comprise two groups differing somewhat in age. The lower fossiliferous beds, from which the bulk of the fossils have been procured, correspond very fairly with the Senonian beds of France, and the Upper Chalk with flints of England. From this horizon all the Cephalopods found in the formation have been derived, with the exception of *Nautilus Danicus*, which was only observed in the upper beds of Ninnyur &c., in the Trichinopoly area, although some specimens were obtained, apparently from a lower horizon, near Pondicherry." ('Manual of the Geology of India,' by H. B. Medlicott and W. T. Blanford, 1879, pt. i. p. 283.)

Locality. Arialur, Trichinopoly district, India.

Represented in the Collection by several specimens, which were presented by Dr. W. King, Director of the Geological Survey of India.

***Nautilus*, sp.**

Among the specimens of *Nautilus* presented to the Museum by Dr. Wm. King, Director of the Geological Survey of India, is a badly preserved cast (No. C. 2603), with, however, remains of ribbing upon it. The shell is umbilicated, and the ribs begin abruptly at the edge of the umbilicus, where they make a sharp bend forward, just at their commencement, widening rapidly upon the sides of the shell, upon which, however, very little of them is preserved. In general form this fossil resembles *Nautilus pseudo-elegans*, Blanford (*non* d'Orbigny); but the absence of all trace of the septa, and the curious feature connected with the ribbing—viz., its abrupt commencement at the edge of the umbilicus, the interior of the latter being quite smooth—combine to make any definite conclusion as to the relations of this shell extremely hazardous.

This specimen when received was erroneously labelled *Nautilus Clementinus*, d'Orbigny, which is a smooth species.

Horizon. Arialur Group? (= Upper Chalk).

Locality. Trichinopoly district, India.

***Nautilus Ahltenensis*?, Schlüter.**

1876. *Nautilus Ahltenensis*, Schlüter, Cephalopoden der oberen deutschen Kreide, Palæontographica, Band xxiv. Abth. ii. p. 176 (56), Taf. xlix. ff. 1, 2.

Sp. Char. Shell compressed, flattened on the sides and periphery, giving a subquadrate form to the aperture. Umbilicus open, but not large. Septa rather numerous, the sutures very slightly curved on the sides of the shell, nearly straight in crossing the periphery. Siphuncle situated nearly in the centre of the septa. Surface of the cast smooth. Test unknown.

Remarks. This species is said by Schlüter to be nearly related to *Nautilus Largilliertianus*, d'Orbigny¹, but in the latter the siphuncle lies very near the inner margin of the septa.

The crushed condition of the specimen representing the present

¹ Palæont. Franç. (Terr. Crét.), vol. i. p. 86, pl. xviii.

species obscures its characteristic form, and it may be doubtful whether we have here the fossil described by Schlüter.

Horizon. Upper Chalk.

Locality. Maestricht (Limburg), Belgium.

Represented in the Collection by a single example (No. 81677).

***Nautilus Darupensis*?, Schlüter.**

1876. *Nautilus Darupensis*, Schlüter, Cephalopoden der oberen deutschen Kreide, Palæontographica, Band xxiv. Abth. ii. p. 176 (56), Taf. xlix. ff. 4, 5.

Sp. Char. Shell somewhat compressed on the sides, with a rather narrowly rounded periphery. Aperture about as wide as high. Umbilicus closed. The septa are very distant from each other, there being only 10 to a whorl in a specimen having a maximum diameter of about 6 inches. The siphuncle is situated very close to the peripheral margin. The surface of the cast is quite smooth.

Remarks. The very distant septa in this species distinguish it from all others which it may in other respects resemble. My friend Mr. G. C. Crick informs me that in some MS. Notes by Dr. Mantell, contained in the Library of the Geological Society of London, there is a sketch of the shell (No. 30212) here referred to *N. Darupensis*.

Horizon. Upper Chalk.

Locality. Sussex.

***Nautilus quadrilineatus*, Favre.**

1869. *Nautilus quadrilineatus*, Favre, Description des Mollusques Fossiles de la Craie des Environs de Lemberg en Galicie, p. 10, pl. iii. ff. 4, a, b.

Sp. Char. Shell inflated, smooth, with rounded sides and periphery. There are two flat spiral bands upon the sides; the inner one, 5 millim. wide, is rather prominent, and is placed at a distance of .73 millim. from the umbilicus. The outer one, narrower and less conspicuous than the other, is situated at the junction of the sides and periphery at .92 millim. from the umbilicus. The umbilicus, though presenting a small opening in the cast, must be completely closed when the shell is preserved. The aperture has a somewhat quadrangular form, rounded in front, higher than wide. The septa are moderately approximate and slightly sinuous, the sutures passing across the periphery with scarcely any curvature. The position of the siphuncle is unknown. A median raised line runs along the periphery. The cast only of this shell is known.

Remarks. In general form this species resembles *N. sublævigatus*, d'Orb., but is distinguished from it by the two spiral bands, by which it is easily recognized.

This seems to be a rare species, as only one specimen was known to its author.

A crushed example (No. 42906) from the Upper Cretaceous of Nagórzany, near Lemberg, in Galicia, may be referred to this species, its inflated form, small umbilicus, and the character of its septa agreeing perfectly with Favre's type. It is also from the same locality as the latter.

Horizon. Upper Cretaceous.

Localities. Westphalia (No. 74040); Nagórzany, near Lemberg, Galicia (No. 42906).

Fairly well represented in the Collection.

***Nautilus Bellerophon*, Lundgren.**

1866. *Nautilus Bellerophon*, Johnstrup, Om Faxekalken ved Annetorp i Skanne; i Oversigt Kongel. Dansk. Vidensk. Selsk. Forhandl. for 1866, no. 6, p. 264. (MS. name.)

1867. *Nautilus Bellerophon*, Lundgren, Palæontologiska Iakttagelser öfver Faxekalken på Limhamn (Ur Lunds¹ Universitets Årsskrift, i.), p. 14, pl. —. ff. 1 a, 1 b.

1869. *Nautilus Dekayi*, Favre, Descrip. des Mollusques Fossiles de la Craie des Environs de Lemberg en Galicie, p. 7, pl. iii. ff. 1, a-c, 2, 3.

? 1875. *Nautilus Dekayi*, Geinitz, Das Elbthalgebirge in Sachsen, pt. ii., Palæontographica, Band xx. Abth. ii. p. 183, Taf. xxxii. ff. 4 a, 4 b.

1885. *Nautilus Bellerophon*, Moberg, Sveriges Geologiska Undersökning, ser. C, no. 73, p. 9, Taf. i. ff. 3-6.

Sp. Char. Shell inflated, rapidly expanding, especially in the region of the aperture, where, owing to the deep peripheral emargination and lateral expansion of the shell, the latter has a bilobate appearance, suggesting that of some species of *Bellerophon*. The umbilicus is very small. The septa are moderately distant and almost straight. The siphuncle is nearly central. The test in the adult shell is marked with subregular lines of growth, which are strongly emarginate in the median line of the periphery; in the young the lines of growth are so distinct as to assume the appearance of fine ribs².

¹ Lund, Sweden.

² As in Favre's figs. 1, a-c (*loc. cit.*).

Remarks. The admirable figures of this species given by Lundgren exhibit its characters perfectly clearly.

Favre has included under the name *Nautilus Dekayi*, Morton¹, forms (such as *N. Bellerophon*, Lundgr., *N. vastus*, Kner, *N. lævigatus*, d'Orbigny, &c.) which, as observed by Meek², are "not only distinct from Dr. Morton's species, but not identical with the species he figures, which has a more dilated aperture than *N. Dekayi*, while it shows little ribs on the inner volutions, somewhat as in *N. elegans* and *N. pseudoelegans*, never seen on *N. Dekayi* at any stage of growth." "His [Favre's] figure," continues Meek, "also represents the siphuncle proportionally more nearly central than in Dr. Morton's species."

In its inflated form and small umbilicus *Nautilus depressus*, Binkhorst (= *N. vastus*, Kner), bears some resemblance to the present species; but the former is a much thicker shell, and, moreover, the siphuncle, instead of being nearly central, as in *N. Bellerophon*, is situated within the upper third of the septa.

Horizon. Upper Cretaceous.

Localities. Nagórzany, near Lemberg, Galicia; Westphalia; Faxoe, Denmark (Upper Chalk).

Well represented in the Collection.

Nautilus Reussii, Fritsch.

1845. *Nautilus inæqualis*, Reuss, Die Versteinerungen der böhmischen Kreideformation, p. 21, Taf. vii. ff. 12, *a*, *b*. (Not of J. Sowerby.)

1872. *Nautilus Reussii*, Fritsch, Cephalopoden der böhmischen Kreideformation, p. 25, Taf. xii. ff. 4 *a*, 4 *b*, 5 *a*, 5 *b*.

Sp. Char. Shell inflated, umbilicus closed. Septa rather distant; sutures nearly straight. Ornaments consisting of fine transverse thread-like lines, crossed by others of a similar character, producing a network of striæ, very commonly met with in the young shells of *Nautilus*.

Remarks. This is a badly characterized species, and it may be only a young example of one already described.

Fritsch makes the following observations upon it:—"The example cited by Reuss from the Baculiten-Schichten agrees in respect to its lobes and other characters with a small example of 15 millim. diameter, derived from the Upper Chalk of Chlomek, near Jungbunzlau. This specimen has part of the test preserved, showing

¹ Synop. Org. Remains, 1834, p. 33, pl. viii. f. 4.

² United States Geol. Surv. Terr. 1876, vol. ix. p. 497.

fine spiral lines. We are, however, not in a position to identify the Bohemian species conclusively with any other, neither have d'Orbigny, Geinitz, Stoliczka, and Sharpe done so. There is a crushed specimen in the Prague Museum from the clay of Priesen, having a diameter of 40 millim., and showing a central siphuncle. Two silicified examples from Böhm.-Leipa are respectively 10 and 15 millim. in diameter. Three examples from Lenešic have very simple and nearly straight sutures. The largest example shows very beautiful cross-barred ornaments upon the shell.

"*Nautilus inequalis*, Sowerby, from the Chalk Marl, is perhaps a small example of *Nautilus sublavigatus*.

"That our *Nautilus Reussii* could be simply a young example of *N. Deslongchampsianus*, as d'Orbigny affirms of *N. sublavigatus*, Sow., can hardly be the case, because our tolerably well-preserved example fails to show any indication of the sharp keel which borders the umbilicus in *N. Deslongchampsianus*."

Horizon. Upper Cretaceous.

Locality. Lenešic, Bohemia.

Represented in the Collection by a single example (No. 89003).

***Nautilus Libanoticus*, Foord and G. C. Crick.**

1878. *Ammonites Traskii*, O. Fraas, Aus dem Orient, Theil ii. Geol. Beobachtungen am Libanon, p. 97, Taf. iv. f. 4. (Not of Gabb.)

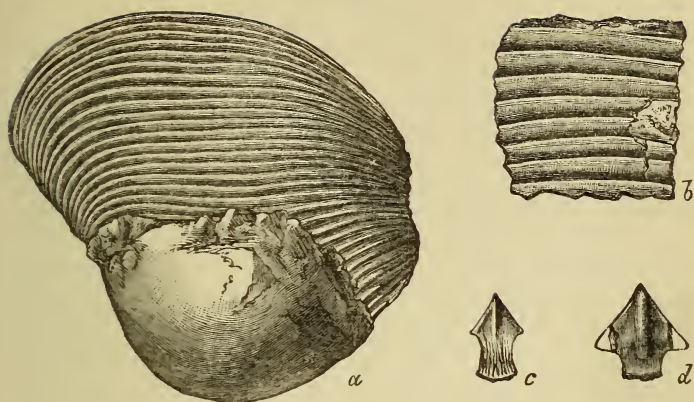
1886. *Nautilus*, sp., Noetling, Entwurf einer Gliederung der Kreideformation in Syrien und Palästina, Zeitschr. der Deutschen geol. Gesell. Band xxxviii. Heft iv. p. 846.

1890. *Nautilus Libanoticus*, Foord and G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 404, f. 6.

Sp. Char. "Shell much inflated, rapidly increasing, broadest in the umbilical region. Umbilicus probably closed. Test ornamented with prominent acute ribs, separated by interspaces rather exceeding their own width. Some of the ribs bifurcate in the region of the umbilicus.

Remarks. "All the specimens are casts more or less crushed and distorted, and nothing is seen in them of the septa or siphuncle; nevertheless the ornaments of the test are sufficient to distinguish the species from others which it may resemble. The general form of *N. Libanoticus* suggests that of *N. elegans*, J. Sowerby, but the character of the ornaments in the latter differs from that of the former, the ribs being at once broader and closer together in Sowerby's species than they are in the present one; and this distinction is maintained even in casts. Fortunately one of our specimens has a portion of the test preserved, and it is here figured

Fig. 67.



Nautilus Libanoticus.—*a*, peripheral view of a distorted specimen (No. C. 542); *b*, portion of the test of another specimen (No. C. 542 *a*); *c*, beak from specimen No. 83663; *d*, beak from No. C. 2918. Drawn from specimens in the British Museum. *a* rather exceeding one half natural size; *b* natural size; *c* and *d* one and a half times natural size.

(fig. 67, *b*). The beaks are exposed to view on the ventral surface of the body-chambers of several of the specimens (fig. 67, *c*, *d*).” (Foord and G. C. Crick.)

Horizon. Upper Cretaceous (Sénouien¹).

Locality. Sâhil Alma, Lebanon, Syria.

Well represented in the Collection.

***Nautilus Dekayi*, Morton.**

1834. *Nautilus Dekayi*, Morton, Synopsis of the Organic Remains of the Cretaceous Group of the United States, p. 33, pl. viii. f. 4.

? 1834. *Nautilus perlatus*, Morton, *ibid.* p. 33, pl. xiii. f. 4.

1847. *Nautilus levigatus*, d'Orbigny, Voyage au Pôle Sud et dans l'Océanie sur les Corvettes l'Astrolabe et la Zélée exécuté pendant les Années 1837–1838–1839–1840, Géologie et Minéralogie, 1854, ii. p. 217, Atlas, Paléontologie, pl. iii. (Géologie, pl. vi.), ff. 1. 2.

1850. *Nautilus Dekayi*, d'Orbigny, Prodrôme de Paléontologie Stratigraphique, vol. ii. p. 211.

1856. *Nautilus Dekayi*, Hall and Meek, Mem. Amer. Acad. Arts and Sci. Boston, vol. v. new series, p. 406.

1856. *Nautilus Dekayi*, Meek and Hayden, Proceed. Acad. Nat. Sci. Philadelphia, vol. viii. p. 280.

¹ See Noetting, Zeitsch. d. Deutsch. geol. Gesell. Band xxxvi. Heft. iv. Tab. facing p. 848.

1858. *Nautilus De Kayi*, Tuomey, Second Biennial Report on the Geology of Alabama (Appendix No. 2), p. 259.
1860. *Nautilus Dekayi*, Conrad, Journ. Acad. Nat. Sci. Philadelphia, vol. iv. new series, p. 276.
1876. *Nautilus Dekayi*, Meek, Report of the United States Geological Survey of the Territories, vol. ix. p. 496, woodcut, f. 67, pl. xxvii. ff. 1, a-e.
- [Not 1857. *Nautilus Dekayi*, Shumard, Trans. Acad. Sci. St. Louis, p. 124 (*fide* Whiteaves¹).—1859. *Nautilus Dekayi*, Binkhorst, Esquisse Géologique et Paléontologique des Couches Crétacées du Limbourg, pp. 8, 38, 40, 53, 67, 91, 146, 169.—1862. *Nautilus Dekayi*, Coquand, Géologie et Paléontologie de la région sud de la Province de Constantine, p. 305.—1866. *Nautilus Dekayi*, Beltrémieux, Faune Fossile du Département de la Charente-Inférieure, p. 80.—1868. *Nautilus Dekayi*, Dewalque, Prodrôme d'une Description Géologique de la Belgique, pp. 358, 397.—1869. *Nautilus Dekayi*, Favre, Description des Mollusques Fossiles de la Craie des Environs de Lemberg en Galicie, p. 7, pl. iii. ff. 2-3.—1879. *Nautilus Dekayi*, Ubaghs, Description Géologique et Paléontologique du Limbourg, p. 201.—1881. *Nautilus Dekayi*, Mourlon, Géologie de la Belgique, vol. ii. p. 101.]

Sp. Char. "Shell subglobose, broadly rounded on the periphery and sides; umbilicus closed; volutions increasing rapidly in size, or more than doubling their diameter each turn, about half as wide again as high, all hidden but the last or outer one; aperture much wider than long, transversely reniform, the lateral extremities being rounded, and the inner side deeply sinuous for the reception of the inner whorls; lip having a wide shallow sinus along the peripheral side, prominently rounded on the lateral margins, and again sinuous near each umbilicus; septa moderately concave, and about sixteen or eighteen to each turn; siphuncle small, located one fourth to one third of the distance across toward the periphery, from the margin of the inner side; surface of adult or medium-sized specimens nearly smooth, or having very obscure lines of growth, crossed by faint traces of longitudinal striæ; on young individuals, or the inner volutions of larger ones, these lines are quite distinct in both directions, and form a very neat, cancellated style of ornamentation; internal casts sometimes showing a slender longitudinal line on the centre of the periphery.

"The proportions are shown by the following measurements of a young individual:—Length 1.84 inches; breadth of aperture 1.70 inches; diameter of aperture in the direction of the length or

¹ Geol. Surv. Canada, Mesozoic Foss. (1879), vol. i. pt. ii. p. 99.

greater diameter of the shell 0·72 inch. Some imperfect adult individuals before me, too much broken to afford exact measurements, were evidently as much as three times the linear dimensions of that from which the foregoing dimensions were taken.

"This common species has been wrongly identified with several foreign forms. D'Orbigny, in his 'Prodr. de Paléont.'¹, expresses the opinion that his own *N. lævigatus*, published in 1846² (not his *N. lævigatus*, 1840), is synonymous with it; also the Indian *N. sphaericus* and *N. Orbignyanus*, Forbes³, and a Chilian form referred by Professor Forbes⁴ to *N. lævigatus*. Mr. Blanford⁵, however, considers both of the Indian shells merely varieties of *N. Bouchardianus*, d'Orbigny, and entirely distinct from *N. Dekayi*, Morton. I have not the necessary specimens at hand to express any decided opinion in regard to the Indian shells figured by Mr. Blanford all belonging to the one species *N. Bouchardianus*; but I can fully concur with him in the opinion that they are certainly distinct from *N. Dekayi*, Morton. The latter differs, as stated by Mr. Blanford, in having its umbilicus always filled with a solid shelly kind of columella, formed by the thickening of the lip at its connection with the body of the shell on each side, instead of being perforated. *N. Dekayi* also has its aperture constantly more transverse, and its siphuncle always nearer the inner side, as may be seen by our figure 1 a, plate 27, which represents very nearly the typical form of the species, as I know from a direct comparison with Dr. Morton's type specimen, now in the Museum of the Academy of Natural Sciences at Philadelphia; . . .

"It is true that Dr. Morton also referred doubtfully to *N. Dekayi*,

¹ Vol. ii. 1850, p. 211.

² "His figures of this shell given in the 'Voyage of the Astrolabe' agree very closely in form, as well as in the outline of the aperture and the position of the siphuncle, with *N. Dekayi*; but as they were drawn from an internal cast only, we have not the means of knowing certainly whether or not the small umbilical perforation seen in the cast was entirely filled with a solid columella-like callosity on each side, as in Morton's species. If it has this character, it may be identical with that form." (Meek.)

³ Trans. Geol. Soc. ser. ii. vol. vii. pt. iii. Report on the Fossil Invertebrata from Southern India, collected by Mr. Kaye and Mr. Cunliffe, pp. 97, 98. *N. lævigatus* and *N. sphaericus*.

⁴ Meek is here in error; the Chilian form is *N. d'Orbignyanus*, not *N. lævigatus*, which is from Southern India. *N. d'Orbignyanus*, Forbes, is described and figured in Darwin's 'Geological Observations,' 1846, pt. iii., Appendix, p. 265, pl. v. ff. 1 a, 1 b. (Parts i. and ii. of this work were published 1842 and 1844 respectively. The main title bears date 1851.)

⁵ Mem. Geol. Surv. of India—Palæont. Indica—i. Cretaceous Cephalopoda of Southern India, 1861, p. 15.

under the provisional name *N. perlatus*, a more compressed form from Alabama, that would doubtless agree more nearly in the outline of its aperture, and in several other respects, with some of the Indian forms, as well as with the Chilian *N. Orbignyianus*, Forbes¹. I have not seen specimens of the Alabama shell showing the position of its siphuncle, but I very much doubt its identity (judging from its form only) with *N. Dekayi* proper, as I have seen no tendency among our specimens (that do not differ also in the position of the siphuncle) to assume this more compressed form." (Meek.)

Remarks. Dr. Morton's original type specimens of *N. Dekayi* are stated by Meek to have come from Monmouth and Burlington Counties, New Jersey, where the species occurs "in the Greensand Marls of the Cretaceous," and also "occurs at various other localities in that State at the same horizon."

Whiteaves² refers to a form described by Dr. B. F. Shumard in the first volume of the 'Transactions' of the Academy of Science of St. Louis (1857, p. 124). It appears that Dr. Shumard identified a species of *Nautilus* found in "the dark, argillaceous, compact limestone of Nanaimo River, Vancouver Island," as *N. Dekayi*, Morton. Mr. Whiteaves remarks that "imperfect or badly preserved specimens of *Nautilus Campbelli* [Meek]³ are difficult to distinguish from *N. Dekayi*, and as Dr. Shumard states that his fossil was in bad condition, it is quite likely that the *Nautilus* which he supposed might be *N. Dekayi* was really *N. Campbelli*, especially when it is borne in mind that the latter species was not described by Meek until 1861, four years after the publication of Dr. Shumard's paper. However this may be, the existence of *Nautilus Dekayi* in the Vancouver Cretaceous is not very satisfactorily established, and needs confirmation. It has not yet been recorded from rocks of similar age in California."

¹ *Horizon.* Cretaceous⁴.

Locality. Sumter Co., Alabama.

Fairly well represented in the Collection.

¹ In Darwin's "Geological Observations on Coral Reefs, Volcanic Islands, and on South America, being the Geology of the Voyage of the 'Beagle,' &c." 1846, pt. iii. Appendix, p. 265.

² Geol. Surv. of Canada, Mesozoic Fossils, vol. i. pt. ii. p. 99.

³ Proc. Acad. Nat. Sci. Philadelphia, 1861, p. 318.

⁴ Probably Upper Cretaceous, but I can find no statement in the report of the Geological Survey of Alabama (1883) with reference to any subdivisions of the Cretaceous in that State.

Nautilus d'Orbignyanus, Forbes.

1846. *Nautilus d'Orbignyanus*, Forbes, Descriptions of Secondary Fossil Shells from South America, in Darwin's "Geological Observations on Coral Reefs, Volcanic Islands, and on South America (Voyage of the 'Beagle')," Appendix, p. 265, pl. v. ff. 1 a, 1 b.

1850. *Nautilus Dekayi*, d'Orbigny (pars, non Morton), Prodr. de Paléont. Stratigr. vol. ii. p. 211.

Sp. Char. "Shell ventricose (probably smooth and slightly umbilicated?). Mouth very broad, reniform. Back rounded. Sutures bend suddenly towards, and nearer to, the umbilicus; on the back they are very slightly sinuated." (*Forbes.*)

Remarks. Forbes further observes that "the form of the chambers resembles that seen in *Nautilus Sowerbyanus*;" but he adds, "the general form more nearly resembles *Nautilus levigatus* [now called *sublevigatus*] of the same author."

Horizon. Cretaceous.

Locality. Concepcion, Chile.

Represented in the Collection by the specimen figured in Darwin's "Geological Observations" (*loc. cit.*).

Nautilus, sp.

Some specimens collected in "Southern Peru, near the borders of Bolivia, from high mountain-ranges," are in such a weathered and imperfect condition as to render it impossible to identify them specifically. One of them (No. 74108 (*a*)) resembles in many respects a specimen figured by MM. Bayle and Coquand¹ under the name of *Nautilus striatus*, J. Sow. They thus describe their fossil:—"Coquille largement ombiliquée, à dos large; cloisons assez rapprochées, légèrement flexueuses, conservant près de l'ombilic, qui est large, des stries fines et très rapprochées, dirigées suivant l'enroulement en spirales de la coquille."

This description agrees fairly well with the British Museum fossil (No. 74108 (*a*)), though the septa in the latter are more numerous than they are represented to be in Bayle and Coquand's figure. No trace of the test remains in the British-Museum specimen, which, in common with the other Peruvian examples, is silicified, causing the jagged edges of the septa to project a little from the matrix, which is composed of a softer material. The siphuncle is not seen.

¹ Mém. Soc. Géol. de France, 1851, sér. ii. vol. iv. pt. i, "Mém. sur les Fossiles recueillis dans le Chili, par M. Ignace Domeyko," p. 8, pl. ii. f. 6.

Another specimen (No. 74108 (l)) resembles the form figured by Bayle and Coquand¹ as *Nautilus semistriatus*, d'Orbigny, the evidence for such determination being, however, very imperfect, the principal character for distinguishing the species, viz., the peripheral striations, being absent in Bayle and Coquand's shell. The British-Museum specimen, though a very imperfect and badly preserved cast, shows that the shell, like Bayle and Coquand's, was distinctly flattened on the periphery, and probably also on the sides. The septa are numerous, the sutures forming a broad, backwardly directed curve on the sides of the shell, and a distinct sinus on the periphery. The umbilicus must have been large, as in Bayle and Coquand's Chilian *Nautilus*. The siphuncle is not seen either in the latter or in the British-Museum example.

The remaining specimen (No. 74108 (c)) is a fragment of a closely septate and widely umbilicated shell in the same mineral condition as the other two, but even more imperfect, therefore no suggestions are offered as to its affinities.

Horizon. Cretaceous.

Locality. Southern Peru, near the borders of Bolivia.

***Nautilus (Hercoglossa) Saxbyi*, Morris.**

1847. *Nautilus Saxbianus*, Fitton, Proceed. Geol. Soc., in Quart. Journ. Geol. Soc. vol. iii. p. 326* (not described).

1848. *Nautilus Saxbii*, Morris, Proceed. Geol. Soc., in Quart. Journ. Geol. Soc. vol. iv. p. 193.

1848. *Nautilus Saxbii*, Morris, Ann. Mag. Nat. Hist. ser. ii. vol. i. p. 106 (woodcut).

1852. *Nautilus Saxbii*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 137.

1854. *Nautilus Saxbii*, Morris, Catalogue of British Fossils, 2nd ed. p. 307.

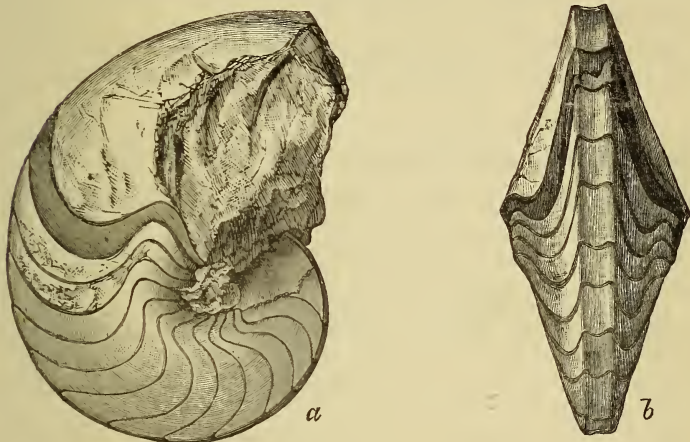
Sp. Char. "Shell discoidal, smooth, slightly umbilicated, with compressed and somewhat angular volutions, contracted towards the margin, with their greatest diameter near to the umbilicus; aperture somewhat triangular [sagittate], laterally compressed, anteriorly truncate, posteriorly impressed or notched by the preceding volution; back flat, or very slightly channelled in the middle. Septa numerous, nearly equal, the margins [sutures] very sinuous and rather incurved as they pass over the back; one sinus [of the sutures] very large; the other, near the umbilicus, small, the intervening saddle

¹ Mém. Soc. Géol. de France, 1851, sér. ii. vol. iv. pt. i. p. 9, pl. i. f. 4.

placed on the greatest convexity of the volutions. Siphuncle subcentral. . . .” (*Morris*.)

Remarks. There are only two species with which *Nautilus Saxbyi* is strictly comparable, viz., *N. Lallierianus*, d’Orbigny¹, from the Upper Neocomian of France and Switzerland, and *N. Vaelsensis*,

Fig. 68.



Nautilus (Hercoglossa) Saxbyi.—*a*, lateral view of a cast, showing the curvature of the sutures; *b*, peripheral view, showing the sulcation of the periphery. The last chamber (shaded dark) is coated with iron-pyrites. Drawn from a specimen (No. 47019—*Morris*'s type) in the British Museum. Rather more than two thirds natural size.

Binkhorst², from the Middle Chalk of Limbourg. *N. Saxbyi* differs from *N. Lallierianus* in its more compressed form, closed umbilicus, and more strongly lobed sutures; from *N. Vaelsensis* it differs in its closed umbilicus, more rapidly increasing whorls, sinuous sutures, and smooth shell.

The highly compressed form and the narrow, truncated, and channelled periphery characterizing this little group of species differentiate it completely from other forms of the Cretaceous rocks, and it is necessary to go back to the Trias in search of species in any way resembling it. Here we find such species as *Nautilus*

¹ Paléontologie Franç., Terr. Crét. 1840, vol. i. p. 620. Also Pictet and Campiche, Terr. Crét. des Environs de Sainte-Croix, Pal. Suisse, 1859, ser. ii. p. 148, pl. xix. ff. 6, *a-c*.

² Mon. des Gastéropodes et des Céphalopodes de la Craie Supérieure du Limbourg, 1861, p. 15, pl. Vc. ff. 2, *a-c*.

mesodiscus (Quenstedt), Hauer ¹, *N. Quenstedti*, Hauer ², *N. guleatus*, Mojsisovics ³, with compressed shells, and very narrow, more or less channelled periphery. It is singular that we meet with no such forms as these in the Jurassic, to connect the Triassic with the Cretaceous ones.

Horizon. Lower Greensand.

Localities. *British.* Atherfield, Isle of Wight.—*Foreign.* Escrag-nolles (Var), France.

Represented in the Collection by two examples, that from Atherfield being the type specimen figured by Morris (No. 47019).

***Nautilus* (*Hercoglossa*) *Lallierianus*, d'Orbigny.**

1840. *Nautilus Lallierianus*, d'Orbigny, Paléont. Franç., Terr. Crét. vol. i. p. 620.

1841. *Nautilus Lallierianus*, d'Orbigny, Des Couches Néocomiennes Supérieures (Aptien) des Environs d'Auxerre, Revue Zool. Soc. Cuvérienne, p. 318.

1850. *Nautilus Lallierianus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. ii. p. 112.

1853. *Nautilus Lallierianus*, Cotteau, Moll. Foss. de l'Yonne (Étage Aptien), p. 6.

1858. *Nautilus Lallierianus*, Pictet et Renevier, Paléont. Suisse, Terr. Apt. p. 170.

1859. *Nautilus Lallierianus*, Pictet et Campiche, Description des Fossiles du Terrain Crétacé des Environs de Sainte-Croix (Paléontologie Suisse), sér. ii. pt. i. pp. 141, 148, pl. xix. ff. 6, a-c.

Sp. Char. Shell very much compressed, flattened on the sides, with truncated and slightly channelled periphery, which is bordered on each side by a ridge, a fainter ridge occupying the median line. Umbilicus small. Aperture compressed, subtriangular, strongly emarginate on the dorsal side. Septa approximate, deeply concave, the sutures forming a deep sinus on the sides of the shell, and a very conspicuous forwardly directed lobe near the umbilicus. Siphuncle near the inner margin. Cast quite smooth; test unknown.

Remarks. This species was never figured by d'Orbigny, who made *N. Saxbyi*, Morris, a synonym of it (Prodr. vol. ii. p. 112); it differs,

¹ Ceph. des Salzkammergutes, 1846, pp. 36, 37, Taf. x. ff. 4-6.

² Neue Ceph. von Hallstatt und Aussee, in Haidinger's naturwiss. Abhandl. iii. p. 6, Taf. ii. ff. 1-3.

³ Das Gebirge um Hallstatt, Theil i. Abhandl. der k.k. geol. Reichsanst. 1873, Band vi. p. 26, Taf. xii. f. 1, Taf. xiii. ff. 1, 3.

however, from the latter in its much greater thickness and more distant septa. From *N. Vaelsensis*, Binkhorst, it is distinguished by its more rapidly increasing whorls, small umbilicus, and more sinuous septa.

Horizon. Neocomian.

Locality. Sentis (Appenzell), Switzerland.

Represented in the Collection by a single fragment.

***Nautilus (Hercoglossa) Danicus*, Schlotheim, sp.**

[See *suprà*, p. 179, f. 32, *b*, *c*.]

1820. *Nautilus Danicus*, Schlotheim, Die Petrefactenkunde, p. 83.
 1834. *Nautilus Danicus*, v. Buch, Neues Jahrbuch für Mineralogie, &c. p. 533.
 1835. *Nautilus Danicus*, Beck, Proceed. Geol. Soc. vol. ii. p. 218.
 1837. *Nautilus Danicus*, Lyell, Trans. Geol. Soc. vol. v. pt. i. p. 250, pl. xviii. ff. 4-7.
 1837. *Nautilus Danicus*, von Buch, Ueber den Jura in Deutschland (Akad. der Wissensch.), p. 119.
 1850. *Nautilus Danicus*, Geinitz, Das Quadersandsteingebirge oder Kreidegebirge in Deutschland, p. 110.
 1850. *Nautilus Danicus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. ii. p. 290.
 1851. *Nautilus Danicus*, d'Orbigny, Neues Jahrbuch für Min. p. 101.
 1852. *Nautilus Danicus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 138.
 1861. *Nautilus Danicus*, Binkhorst, Mon. des Gastéropodes et des Céphalopodes de la Craie Supérieur du Limbourg, pt. ii. p. 16.
 1865. *Nautilus Danicus*, Blandford, Mem. Geol. Surv. India—Palæont. Indica—i. Foss. Ceph. Cretaceous Rocks of S. India, p. 24, pl. x. ff. 4, 4 a, pl. xi.
 1865. *Nautilus Danicus*, Stoliczka, *ibid.* p. 203.
 1867. *Nautilus Danicus*, Lundgren, Palæontologiska Iakttagelser öfver Faxekalken på Limhamn (Ur Universitets Årsskrift), p. 12.
 1868. *Nautilus Danicus*, Dewalque, Prodrome d'une Description Géologique de la Belgique, p. 358.
 1868. *Nautilus Danicus*, Stoliczka, Rec. Geol. Surv. India, no. 2, p. 32.
 1885. *Nautilus Danicus*, Moberg, Sveriges Geologiska Undersökning, ser. C, no. 73, p. 11, Taf. i. ff. 7-12.
 1890. *Nautilus (Hercoglossa) Danicus*, Foord and G. C. Crick, Ann. Mag. Nat. Hist. ser. 6, vol. v. p. 407, f. 8.

Sp. Char. "Shell subinflated, flattened on the sides, narrowly rounded on the periphery; umbilicus closed. Septa moderately distant, being 5 lines apart on the periphery, where the height of the whorl is 11 lines. Sutures forming an acute, forwardly-directed lobe near the umbilicus, then bending backwards into a somewhat broader lobe, and again directed forwards towards the

periphery, in crossing which they make a broad arch. There is a very distinct internal (dorsal) lobe in young specimens. The siphuncle is a little below the centre. The test is unknown.

Remarks. "This species is distinguished from *Nautilus Francicus* by the form of its shell, which has a rounded instead of a truncated periphery; its siphuncle also is differently placed. There is no species in the Chalk of Europe with which it may be compared. *N. Danicus* has been recognized by H. F. Blanford¹ in the upper part of the Arrialoor Group (Cretaceous) of Southern India. Mr. Blanford found that the only difference between the Indian specimens and the figures of *N. Danicus* given by Lyell in the Trans. Geol. Soc. (*loc. cit.*) was 'a somewhat greater compression of form' in some of the former; this he found, however, to be a variable character in the Indian specimens. He remarks that the very large size to which the Trichinopoly specimens occasionally attain can scarcely be regarded as a specific character. The internal lobe is present in young examples of the Indian specimens, disappearing in older ones. In the volume already quoted² Stoliczka has the following remarks on the present species:—"So far as the existing figures of *N. Danicus* [Trans. Geol. Soc., *loc. cit.*] allow an opinion to be formed, the Indian fossil does not vary from the European, except in the usually greater thickness of the whorls.' The following species from the Cretaceous rocks of Southern India form a group of which *N. Danicus* is the European representative, viz. *N. serpentinus*, Blanford³, *N. Forbesianus*, Blanford⁴, *N. Trichinopolitensis*, Blanford⁵." (*Foord and G. C. Crick.*)

A cast of the body-chamber of this species, presented by J. E. Lee, Esq., F.S.A., F.G.S., measures $4\frac{1}{2}$ inches in its greatest diameter. This is the largest specimen in the Collection. There are obscure folds upon its surface, radiating from the umbilicus.

We learn from Lundgren⁶ that a species of *Nautilus* referred by

¹ Mem. Geol. Surv. India—Palæont. Indica—1861, ser. i. Cret. Ceph. of Southern India, p. 24.

² Mem. Geol. Surv. India—Palæont. Indica—1866, ser. iii. Cret. Ceph. of Southern India, p. 208.

³ Mem. Geol. Surv. India—Palæont. Indica—ser. i. 1861, p. 25, pl. xii. ff. 1, 1 a. Ibid. ser. iii. 1866, p. 208, pl. xcii. f. 2.

⁴ Ibid. p. 26, pl. xiii. *Forbesianus* was afterwards changed by Stoliczka (ibid. p. 208) to *Ootatoorensis*, on the ground that d'Archiac had already described a *Nautilus Forbesi* from the Nummulitic rocks of the Punjab.

⁵ Ibid. p. 37, pl. xxiii., pl. xxiv. ff. 1, 2. Ibid. ser. iii. 1866, p. 212.

⁶ Palæontologiska Iakttagelser öfver Faxekalken på Limhamn (Ur Universitets Årsskrift), 1867, p. 14.

Professor F. Johnstrup¹ to the *N. fricator* of Beck² belongs in reality to the present species. Beck's species, though recognized by Lundgren, was apparently never described. Lundgren speaks of it as represented by a fragment contained in the Berlin Museum (?).

Horizon. Upper Chalk.

Locality. Faxoe, Denmark.

***Nautilus (Hercoglossa) Trichinopolitensis*, Blanford.**

1851. *Nautilus Trichinopolitensis*, Blanford, Mem. Geol. Surv. India—Palæont. Indica—i. Foss. Ceph. of the Cretaceous Rocks of Southern India, p. 37, pl. xxiii., pl. xxiv. ff. 1, 1 a, 2, pl. xxv. ff. 3, 3 a.

1866. *Nautilus Trichinopolitensis*, Stoliczka, *ibid.* p. 212.

1879. *Nautilus Trichinopolitensis*, Medlicott and Blanford, Manual of the Geology of India, pt. i. p. 284.

Sp. Char. "Shell discoid, compressed, ornamented with strong flexuous ribs, continuous to the umbilicus, acutely angulated on the back, and separated by narrow deeply cut grooves, which are faintly impressed on the cast. Umbilicus moderate with sloping sides; inner whorls concealed. Ventral area evenly rounded. Aperture ovate, narrower in front, sometimes flattened at the sides. Septa deeply sinuated, forming a rounded, compressed lobe above the middle of the whorl. The base of the lobe is evenly rounded on both sides. On the ventral [peripheral] surface the edges of the septa [sutures] are either straight or slightly concave, the latter generally in old specimens. Siphuncle rather large, situated at three fourths the height of the septum.

"This well-marked species is confined to the Arrialoor Group³, and appears to be of very local occurrence. The specimens are principally casts, but in good preservation." (*Blanford.*)

Remarks. This species is derived from the lower part of the Arrialur Group, and is found in Koloture, Arrialur, and Mullur, in the Trichinopoly district.

Stoliczka, in his revision of the Nautili of the Cretaceous rocks of Southern India (see table of reference above), observes that the umbilicus in the present species is "sometimes closed, but always with a distinct funnel-shaped depression; other specimens are dis-

¹ Om Faxekalken ved Annetorp i Skaane; i Oversigt Kongl. Dansk. Vidensk. Selsk. Forhandl. for 1866, no. 6, p. 258.

² "Notes on the Geology of Denmark," Proceed. Geol. Soc. 1835, vol. ii. p. 218.

³ See 'Manual of the Geology of India,' by H. B. Medlicott and W. T. Blanford, pt. i. 1879, p. 280.

tinctly umbilicated, even when the shell is preserved." The species, he adds, "is characterized by its lateral compression, the laterally strongly sinuous septa, and the external siphuncle." A specimen of *N. (H.) Trichinopolitensis* was erroneously included by Blanford under his species *N. rota*, on plate xxv. of the work quoted above; this error was corrected by Stoliczka in his revision of the Nautili (p. 212 of the same work).

Horizon. Arialur Group (= Upper Chalk of England, Senonian of France).

Locality. Arialur, Trichinopoly district, India.

TERTIARY SPECIES.

***Nautilus centralis*, J. Sowerby.**

1812. *Nautilus centralis*, J. Sowerby, Min. Conch. vol. i. p. 11, pl. i. (left-hand figure).
 1825. *Nautilus Australis* (by error for *centralis*), DeFrance, Dict. des Sciences Naturelles, vol. xxxiv. p. 297.
 1836. *Nautilus centralis*, Wetherell, London, Edinburgh, and Dublin Phil. Mag. and Journ. Sci. vol. ix. p. 465.
 ? 1840. *Nautilus Bucklandi*¹, Michelotti, Indice ragionato di alcuni Testacei de Cefal. foss. &c., Ann. delle Scien. del Regno Lomb.-Veneto, p. 4. (Not of Sowerby.)
 ? 1847. *Nautilus Bucklandi*, Michelotti, Descrip. des Fossiles des Terrains Miocènes de l'Italie Septentrionale, p. 348.
 1849. *Nautilus centralis*, Edwards, Mon. of the Eocene Cephalopoda and Univalves of England, vol. i. (Pal. Soc.), p. 45, pl. iii. ff. 1 a-c.
 1849. *Nautilus centralis*, Dixon, Geology and Fossils of the Tertiary and Cretaceous Formations of Sussex, pp. 110, 121, 228, pl. xiv. f. 28.
 1850. *Nautilus centralis*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. ii. p. 338.
 1852. *Nautilus imperialis* (pars), Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 151.
 1854. *Nautilus centralis*, Morris, Cat. of British Fossils, 2nd ed. p. 306.
 1854. *Nautilus centralis*, Pictet, Traité de Paléontologie, 2nd ed. vol. ii. p. 629.
 1872. *Nautilus centralis*, Whitaker, Geology of the London Basin, Mem. Geol. Surv. of England and Wales, vol. iv., Appendix, p. 589.
 1890. *Nautilus centralis*, Foord and G. C. Crick, Ann. Mag. Nat. Hist. ser. 6, vol. v. p. 391.

Sp. Char. "The *Nautilus centralis* in the simplicity of the septa

¹ This name was changed by d'Orbigny to *Michelotti, Bucklandi* being pre-occupied (Prodr. de Pal. Strat. vol. iii. 1852, p. 25).

and the central position of the siphuncle nearly resembles the recent Nautili. It is a very ventricose, almost a globose shell, much rounded on the ventral aspect; the aperture is bluntly lunate, nearly semicircular, and is rather more than twice as wide as it is long; the open umbilicus is narrow and deep; the septa are concave outwardly, and simple, scarcely presenting any undulation or second curvature whatever; the dorsal lobes are broad, each being nearly one third of the width of the aperture, and they are bluntly rounded on their superior margins; the siphuncle is very small, central, or nearly so, and continuous. The lines of growth present broad undulations, and are strongly marked and decussated.

“Michelotti has described a Nautilus from the Miocene formations of the Colle de Torino, in Piedmont, to which he has given the name *Bucklandi*. He quotes *N. centralis* of Sowerby by the name *N. australis* (an error into which he has fallen by relying on Defrance's quotation), and he considers his shell to be identical with it, and, oddly enough, associates with it *N. imperialis*. The specific description given by this author agrees tolerably well with that of the present species; but I have not myself had any opportunity of comparing the Piedmontese with the English shells; and as Michelotti does not mention his having compared the two, and he appears to have trusted implicitly to Defrance, the accuracy of the identification must for the present be considered as doubtful.” (*Edwards*.)

Remarks. This species is easily distinguished from *Nautilus regalis* by its inflated form and the greater width of the aperture compared with the height. It comes nearer to *N. imperialis*, from which species, however, it differs in its greater width and closed umbilicus.

“This species,” remarks Edwards, “does not appear to have attained a great size, the largest specimen not exceeding 3·7 inches in diameter, by 3·3 across.” “It occurs,” he adds, “at Regent's Park, Chalk Farm, Hyde Park, Richmond, Sheppey, and Bognor; it is also found, though very rarely, at Bracklesham Bay.”

Horizon. London Clay (Lower Eocene).

Localities. Whetstone, Chalk Farm, Hadley, Maida Hill (London); Middlesex: Isle of Sheppey: Bognor, Bracklesham, Sussex.

Well represented in the Collection, which contains the specimen (No. 69651) figured by Edwards (*Mon. Pal. Soc.* pl. iii. f. 1), and also the one figured by Dixon in the ‘*Geology of Sussex*,’ pl. xiv. f. 28.

***Nautilus regalis*, J. de C. Sowerby.**

- ? 1823. *Nautilus regalis*, J. Sowerby, Min. Conch. vol. iv. p. 77, pl. ccciv.
- ? 1825. *Nautilus regalis*, Defrance, Dict. des Sciences Naturelles, vol. xxxiv. p. 300.
1836. *Nautilus regalis*, Wetherell, London, Edinburgh, and Dublin Phil. Mag. and Journ. Sci. vol. ix. p. 465.
- ? 1837. *Nautilus Burtini*, Galeotti, Mém. sur la Constitution Géognostique de la Province de Brabant, p. 140. (Figured by Burtin, Oryctographie de Bruxelles, 1784, p. 102, pl. xiv.) (*Fide* d'Orbigny, Prodr. de Paléont. Stratigr. vol. ii. 1850, p. 338.)
1843. *Nautilus regalis*, J. de C. Sowerby, Min. Conch. vol. vii. p. 35, pl. dxxxvii. f. 5 (erroneously marked 6 in some copies of the book).
1849. *Nautilus regalis*, Edwards, Mon. of the Eocene Cephalopoda and Univalves of England, vol. i. (Pal. Soc.) p. 46, pl. iv.
1849. *Nautilus regalis*, Dixon, Geology and Fossils of the Tertiary and Cretaceous Formations of Sussex, pp. 121, 228.
1850. *Nautilus regalis*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. ii. p. 338.
1852. *Nautilus regalis*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 156.
1854. *Nautilus regalis*, Morris, Cat. of British Fossils, 2nd ed. p. 306.
1854. *Nautilus regalis*, Pictet, Traité de Paléontologie, 2nd ed. vol. ii. p. 629.
- ? 1858. *Nautilus regalis*, Ooster, Cat. des Céphalopodes Fossiles des Alpes Suisses, pt. iii. p. 17.
1872. *Nautilus regalis*, Whitaker, Geology of the London Basin, Mem. Geol. Surv. of England and Wales, Appendix, p. 589.
1890. *Nautilus regalis*, Foord and G. C. Crick, Ann. Mag. Nat. Hist. ser. 6, vol. v. p. 391.

Sp. Char. "This species is distinguishable from the preceding [*N. centralis*] by the closed umbilicus, and by its general form, which is less ventricose than that of *N. centralis*. It is a smooth shell, flattened on the sides and bluntly rounded, and obscurely undulated on the ventral aspect. The aperture presents a subquadrate appearance. The umbilicus is closed by a thickening of the lip, assuming the appearance of a solid axis to the shell. The septa are nearly simple, presenting on each side slight undulations, and the short rounded dorsal lobes are deeply concave, and not reflected. In the young shell the septum is characterized by a conical depression [=inner or dorsal lobe of the sutures] placed on the dorsal margin close to the preceding whorl; as the shell enlarges this gradually decreases in size and depth, and ultimately disappears. It was, of course, moulded on a corresponding protuberance on the

animal, probably an enlargement of the epithelial cincture. It was on this character that De Montfort, mistaking the depression for the mouth of a second siphuncle, founded his genus *Bisiphites*. The siphuncle is small and excentric. The lines of growth, like those of the preceding species, are decussated, and reflected backwards in broad undulations." (*Edwards*.)

Remarks. There is a notable discrepancy between J. Sowerby's description and figure of this species and those of J. de C. Sowerby and F. E. Edwards. J. Sowerby's description runs thus:—"Gibbose, plain, not umbilicate; front flattish; sides convex; aperture rather wider than long." Sowerby continues:—"The volutions of this *Nautilus* increase rather more rapidly in size than those of *N. imperialis*, which is near akin to it, and from which it is further distinguished by the solid columella or axis, by the convex, not straight, sides of the aperture or section in the young shells, and the expanded sides and straight front of the aperture in the adult . . . I have named it *regalis*, as it seems little inferior in splendour to the *imperialis*, and nearly equals it in size, though it appears from two or three specimens I have with small remains of the thickened edge of the aperture near the axis, that it is full-grown when about nine inches in diameter and five in thickness."

It will be observed that J. Sowerby in his description of *N. regalis* describes his shell as having the "sides convex," and the "aperture rather wider than long," and this is expressed in his figures (pl. ccclv.); but in the descriptions and figures of this species given by J. de C. Sowerby and F. E. Edwards no such impression of the form of the shell is conveyed; on the contrary, J. de C. Sowerby's figure represents a shell with flattened sides and an aperture which is higher than wide, and Edwards's description and figures lead to the same conclusion as to the shape of the shell, the aperture of which he says "presents a subquadrate appearance," and the shell is "flattened on the sides." As it would be impossible to reconcile these divergent descriptions, it becomes a question whether J. Sowerby's name *regalis* can be retained, especially as his type specimen is not to be found. I have thought it best, however, to retain the name for the species figured by J. de C. Sowerby, who was very probably acquainted with J. Sowerby's figured specimen. Edwards's figures and description fully supplement those of J. de C. Sowerby, and they manifestly refer to a similar species, of which there are numerous examples in the British Museum. This affords another instance of the difficulty of recognizing species from fore-shortened figures.

Two small specimens (No. 3398, 3399) from Kressenberg, Upper Bavaria, agree perfectly with the present species; the siphuncle and sutures, with the inner lobe, are well seen in one of them.

Two rolled fragments are referable to this species. They are from the Red Crag of Felixstowe, but were derived from the London Clay.

This species, as observed by Edwards, attained a large size. A large specimen (No. 6931) in the British Museum (and there are many such) measures nearly 9 inches in diameter. It is recorded by Edwards from Islington, Regent's Park, Chalk Farm, and Hyde Park, in the London District, and from Bognor in Sussex.

Horizon. London Clay (Lower Eocene). Red Crag (Newer Pliocene).

Localities. British. Whetstone, Hornsey, near Chalk Farm, Potter's Bar, Middlesex; Isle of Sheppey; coast of Essex; Felixstowe, Essex (Red Crag).—*Foreign.* Kressenberg, Upper Bavaria.

Represented in the Collection by very numerous specimens, including J. de C. Sowerby's figured type (No. 43846 in the "Sowerby Collection").

***Nautilus urbanus*, J. de C. Sowerby.**

1843. *Nautilus urbanus*, J. de C. Sowerby, Min. Conch. vol. vii. p. 36, pl. dxxxviii.

1849. *Nautilus urbanus*, Edwards, Mon. of the Eocene Cephalopoda and Univalves of England, vol. i. (Pal. Soc.), p. 46, pl. iii. ff. 2 a, b. (Drawn from Sowerby's specimens.)

1854. *Nautilus urbanus*, Pictet, Traité de Paléontologie, 2nd ed. p. 629.

1854. *Nautilus urbanus*, Morris, Cat. of British Fossils, 2nd ed. p. 306.

1872. *Nautilus urbanus*, Whitaker, Geology of the London Basin, Mem. Geol. Surv. of England and Wales, vol. iv. Appendix, p. 589.

1890. *Nautilus urbanus*, Foord and G. C. Crick, Ann. Mag. Nat. Hist. ser. 6, vol. v. p. 391.

Sp. Char. "A flat discoidal shell, rounded on the ventral aspect, and presenting obscure undulations similar to those which characterize *N. regalis*. The aperture has an elongated, subquadrate shape; the umbilicus is narrow; the septa concave, and slightly undulated; they present on each side, in a line with the preceding whorl, a slight depression, which appears to be the first indication of the lateral lobes so fully developed in the *N. Parkinsoni*; the siphuncle is excentric, approaching the dorsal margin; the dorsal lobes are short, very slightly concave, obliquely truncated, and not recurved. The lines of growth are prominent, and decussated more

strongly than those of the two preceding species, and their undulations are broad and shallow.

"The *Nautilus urbanus* is distinguishable from *N. centralis* by its flatness, and the greater length [or height] of its aperture; and from *N. regalis* by its open umbilicus, the truncated extremities of the dorsal lobes of the septa, and its discoidal shape. It is a very rare shell. The figures 2*a*, 2*b*, tab. iii. [Edwards's plate] are taken from the shells drawn in 'Mineral Conchology' [vol. vii. 1843, pl. dxxxviii.], the only specimens with which I am acquainted. The larger one, belonging to Mr. Sowerby, was found in excavating St. Katherine's Docks, near the Tower of London; the smaller one forms part of Mr. Bowerbank's collection, and was obtained from Sheppey." (*Edwards.*)

Remarks. The dimensions of the individual last mentioned are $7\frac{1}{4}$ inches in diameter and $3\frac{1}{4}$ in width: it is now in the "Sowerby Collection" (No. 44061). A still larger specimen (No. 69646), from the London Clay near Whetstone, has a maximum diameter of $8\frac{1}{2}$ inches. The smaller specimen (No. 71001) is also in the British Museum.

Giebel (*Fauna der Vorwelt*, Band iii. Abth. i. 1852, p. 152) places *N. urbanus*, J. de C. Sow., as a synonym of *N. umbilicaris*, Deshayes¹, but the latter is a much more inflated shell with a larger umbilicus than Sowerby's species.

Horizon. London Clay (Lower Eocene).

Localities. St. Katherine's Docks, London ("Sowerby Coll."); Isle of Sheppey (No. 71001); near Whetstone, Middlesex.

Well represented in the Collection.

***Nautilus imperialis*, J. Sowerby.**

1812. *Nautilus imperialis*, J. Sowerby, Min. Conch. vol. i. p. 9, pl. i.

? 1824. *Nautilus Lamarkii*, Deshayes, Descr. des Coquilles Fossiles des Environs de Paris, vol. ii. p. 767, pl. c.

1825. *Nautilus imperialis*, Defrance, Dict. des Sciences Naturelles, vol. xxxiv. p. 297.

1836. *Nautilus imperialis*, Wetherell, London, Edinburgh, and Dublin Phil. Mag. and Journ. Sci. vol. ix. p. 465.

1849. *Nautilus imperialis*, Edwards, Mon. of the Eocene Cephalopoda and Univalves of England, vol. i. (Pal. Soc.), p. 47, pl. v.

1849. *Nautilus imperialis*, Dixon, Geology and Fossils of the Tertiary and Cretaceous Formations of Sussex, pp. 109, 120, 228.

¹ Descr. des Coquilles Fossiles des Environs de Paris, 1824, vol. ii. p. 767, pl. xcix.

1850. *Nautilus imperialis*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. ii. p. 338.
 1852. *Nautilus imperialis* (pars), Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 151.
 1854. *Nautilus imperialis*, Morris, Cat. of British Fossils, 2nd ed. p. 306.
 1872. *Nautilus imperialis*, Whitaker, Geology of the London Basin, Mem. Geol. Surv. of England and Wales, vol. iv. p. 589.
 1890. *Nautilus imperialis*, Foord and G. C. Crick, Ann. Mag. Nat. Hist. ser. 6, vol. v. p. 391.

Sp. Char. "The *Nautilus imperialis* is a somewhat globose shell, rather narrow on the ventral aspect, whence the aperture assumes a subelliptical form; the umbilicus is small and deep . . . generally it is found open only in young shells; in the larger specimens it is usually filled with pyrites or indurated clay. The septa are deeply concave, and present a gentle undulation on each side; the dorsal lobes are very broad, inflected towards the axis, and obliquely truncated on the inferior margins. The siphuncle is moderately large and excentric, being placed on the dorsal [inner] side of the centre of the disc [*i. e.* below the centre of the septa]. It appears to vary in its position, gradually becoming more distant from the dorsal margin as the shell enlarges [a change of position which is of frequent occurrence in Nautili]. The lines of growth are reflected backwards in a deep narrow wave, and in the specimens I have seen are not decussated as in the three preceding species.

"In the shell described by Michelotti under the name *N. Bucklandi*, and with which he has associated the present species, the siphuncle is central; and that character is, in fact, the reason assigned by him for considering his shell to be identical with *N. centralis* as well as with *N. imperialis*. Whether the alleged identification of *N. Bucklandi* with *N. centralis* be correct or not, it is obvious that the Piedmontese shell cannot be referred to the present species. DeFrance states that the *N. imperialis* did not appear to differ from *N. centralis*, and Michelotti has, in fact, relied implicitly on that author; he has even copied the mistake made in quoting *N. centralis* as *N. australis*." (*Edwards*.)

Remarks. *N. imperialis* attained a large size; a specimen from the Isle of Sheppey, contained in the Museum of the Geological Society of London, has a diameter of 1 foot and a width of 8½ inches.

The largest specimen in the British Museum (No. C. 3401) is 11 inches in diameter.

This is rather a widely distributed species, as may be seen by a reference to the list of localities.

Horizon. London Clay (Lower Eocene).

Localities. Highgate Archway, Hampstead, Primrose Hill, Whetstone, near Kew Bridge, near Chalk Farm; Middlesex: Sydenham, Woking; Surrey: Isle of Sheppey.

Well represented in the Collection, which includes the specimens figured by J. Sowerby, and J. de C. Sowerby in the 'Mineral Conchology.' No. 16870 was presented by Sir William Clay, Bart.

Bellardi¹ places *N. Bucklandi*, Michelotti, in the synonymy of *N. Allionii*, Michelotti², and states that the latter is distinct from *N. imperialis*, J. Sow., the former being a Miocene and the latter an Eocene species.

***Nautilus Sowerbyi*, Wetherell.**

1836. *Nautilus Sowerbyi*, Wetherell, London, Edinburgh, and Dublin Phil. Mag. and Journ. Sci. vol. ix. p. 466.
 1843. *Nautilus Sowerbyi*, J. de C. Sowerby, Min. Conch. vol. vii. p. 35, pl. dxxxvii. ff. 1-3.
 1849. *Nautilus Sowerbyi*, Dixon, Geology and Fossils of the Tertiary and Cretaceous Formations of Sussex, p. 121, pl. xiv. f. 28.
 1849. *Nautilus Sowerbyi*, Edwards, Mon. of the Eocene Cephalopoda and Univalves of England, vol. i. (Pal. Soc.), p. 48, pl. vi.
 1852. *Nautilus Sowerbyi*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 162.
 1854. *Nautilus Sowerbyi*, Morris, Cat. of British Fossils, 2nd ed. p. 306.
 1854. *Nautilus Sowerbyi*, Pictet, Traité de Paléontologie, 2nd ed. vol. ii. p. 629.
 1872. *Nautilus Sowerbyi*, Whitaker, Geology of the London Basin, Mem. Geol. Surv. of England and Wales, vol. iv. p. 589.
 1886. *Nautilus Sowerbyi*, Kaufmann, Beiträge zur Geol. Karte der Schweiz, Lief. xxiv. p. 281.
 1890. *Nautilus Sowerbyi*, Foord and G. C. Crick, Ann. Mag. Nat. Hist. ser. 6, vol. v. p. 391.

Sp. Char. "The *N. Sowerbyi* is an exceedingly well-marked species. It is a smooth, discoidal, convex, or rather lenticular shell, somewhat resembling in shape the Dax form of *Aturia* (*Nautilus*) *ziczac*, but it is narrower towards the margin, which circumstance gives a triangular form to the aperture. The septa are very concave, and present on each side a broad undulation, with a deep sinus-like depression caused by a lateral lobe, more developed in this species than in *N. urbanus*, although not attaining the size and

¹ I Molluschi dei Terreni Terziari del Piemonte e della Liguria, 1872, pt. i. p. 21.

² Descr. des Fossiles des Terrains Miocènes de l'Italie septentrionale, 1847, p. 347.

importance of that which distinguishes *N. Parkinsoni*. The dorsal lobes are much recurved and obliquely truncated: the siphuncle is moderately large, placed very near to the dorsal margin, and continuous. The striæ of growth towards the middle are suddenly bent backwards in deep undulations." (*Edwards.*)

Remarks. This species is distinguished by the extreme narrowness of the periphery, which causes the umbilical region to appear very prominent, and gives a distinctly lenticular form to the shell. It is said by Edwards to have been common in the Isle of Sheppey and at Bognor.

The largest specimen in the Collection (No. 16157) measures 10 inches in its greatest diameter. The specimen (No. 32726) figured by Dixon is nearly as large. Unfortunately neither of these specimens is localized.

Horizon. London Clay (Lower Eocene).

Localities. Holloway, Potter's Bar, Whetstone, Finchley; Middlesex: Isle of Sheppey.

Well represented in the Collection, which includes the specimen (No. 32726) part of which was figured by Dixon in the 'Geology of Sussex,' pl. xiv. f. 15. No. 16157 was presented by E. H. Handley, Esq.

Species of Doubtful Validity.

The following species, viz. *Nautilus ellipticus*, Schafhäütl, and *N. macrocephalus*, Schafh., from the Eocene formation of Kressenberg¹, Bavaria, are casts in a coarsely granular matrix upon which not an atom of the test is preserved, though the sutures of the septa are traceable, more or less imperfectly, in all the specimens. Under these circumstances one is very much inclined to doubt the validity of such species, in which, owing to the coarseness of the matrix, so many characters, required to found species upon, are wanting.

Nautilus ellipticus, Schafhäütl.

1852. *Nautilus ellipticus*, Schafhäütl, Der Teisenberg oder Kressenberg in Bayern, in Leonhard and Bronn's Neues Jahrbuch für Min. &c. p. 165.

¹ A mountain in the district of Traunstein, Upper Bavaria. A full description of the Kressenberg Beds may be seen in Gümbel's "Geogn. Beschreibung des bayerischen Alpengebirges und seines Vorlandes," Geogn. Karte des Königreiches Bayern, 1861, pp. 586-602.

1863. *Nautilus ellipticus*, Schafhüttl, Süd-Bayerns Lethæa Geognostica,—Der Kressenberg und die südlich von ihm gelegenen Hochalpen, p. 214, Taf. lvii. and Taf. lviii.

1890. *Nautilus ellipticus*, Foord and G. C. Crick, Ann. Mag. Nat. Hist. ser. 6, vol. v. p. 391.

Sp. Char. Shell (cast) somewhat compressed on the sides, rather narrowly rounded on the periphery; greatest width in the umbilical region; umbilicus closed. Septa rather approximate; sutures nearly straight on the periphery, but bent strongly backwards on the sides, and forming a conspicuous, forwardly directed lobe on the margin of the umbilicus, into which they abruptly descend. Siphuncle not seen.

Remarks. This species bears a considerable resemblance to *Nautilus imperialis*, J. de C. Sowerby, and it may possibly be identical with that species; but its mineral condition, in common with that of the other species from Kressenberg, prevents any definite determination as to its affinities from being arrived at.

N. ellipticus is represented in the Collection by two examples, the largest of which (No. C. 3402) measures $8\frac{1}{4}$ inches in its greatest diameter. The smaller one (No. C. 1003) is the more perfect of the two, and has furnished the data for the above description of the species. It was presented to the British Museum by Mr. J. E. Lee, Esq., F.G.S.

Horizon. Eocene.

Locality. Kressenberg, Upper Bavaria.

***Nautilus macrocephalus*, Schafhüttl.**

1863. *Nautilus macrocephalus*, Schafhüttl, Süd-Bayerns Lethæa Geognostica,—Der Kressenberg und die südlich von ihm gelegenen Hochalpen, p. 215, Taf. liv. ff. 2, a-c.

1890. *Nautilus macrocephalus*, Foord and G. C. Crick, Ann. Mag. Nat. Hist. ser. 6, vol. v. p. 391.

Sp. Char. Shell (cast) inflated, nearly as wide as high, slightly compressed on the sides, broadly rounded on the periphery. Umbilicus open, small. Septa rather approximate; sutures forming a conspicuous, forwardly directed lobe near the edge of the umbilicus, then bent backwards on the sides, and passing over the periphery without any curvature. Umbilicus (according to Schafhüttl's figure) very near the dorsal (inner) margin of the septa.

Remarks. This species reminds one of *Nautilus centralis*, J. Sow., of which it may be a giant form, but its characters are too little known to warrant any definite conclusion as to its affinities.

A specimen with a label accompanying it—" *Nautilus nobilis*, Münst."—may also belong to this species. No species under that name seems ever to have been described, and it has probably been quoted from a Museum label. It is cited in Bronn's 'Index Palæontologicus,' Abth. i. Hälfte ii. 1848, p. 794, with a reference to Keferstein's 'Deutschland geogn. Dargestellt,' 1828, vi. 95; see preface of Schafhäütl's Süd-Bayerns Leth. Geogn. 1863, p. xiii. *N. nobilis* is also mentioned by Schafhäütl (in Neues Jahrb. für Min. 1852, p. 164), who says that no species under that name could be found in Münster's Collection.

Horizon. Eocene.

Locality. Kressenberg, Upper Bavaria.

Nautilus Deluci, d'Archiac.

1854. *Nautilus Deluci*, d'Archiac, Description des Animaux Fossiles du Groupe Nummulitique de l'Inde, par le Vicomte d'Archiac et Jules Haime, livr. ii. p. 337, pl. xxxv. ff. 2, 2 a.

1854. *Nautilus major*, Carter, Summary of the Geology of India, between the Ganges, the Indus, and Cape Comorin, Journal of the Bombay Branch of the Royal Asiatic Society, vol. v. p. 254.

1857. *Nautilus Deluci*, Carter, Summary of the Geology of India, reprinted with "Footnotes" from the Journal of the Bombay Branch of the Royal Asiatic Society, vol. v. p. 179, in "Geological Papers on Western India," &c., edited by H. J. Carter, p. 700 (footnote).

1879. *Nautilus Deluci*, Medlicott and Blanford, A Manual of the Geology of India, pt. ii. p. 452.

1880. *Nautilus Deluci*, Fedden and Blanford, Mem. Geol. Surv. of India, vol. xvii. pp. 39, 210.

1890. *Nautilus Deluci*, Foord and G. C. Crick, Ann. Mag. Nat. Hist. ser. 6, vol. v. p. 391.

Sp. Char. Shell (cast) much compressed on the sides, widest in the umbilical region, thus giving the shell a lenticular form. Periphery angular in the young, but becoming a little wider in the adult shell, in which it is even slightly channelled (No. 36941). Umbilicus small. Septa rather approximate; sutures forming a very conspicuous lobe in the region of the umbilicus into which they abruptly descend; on the sides they form a broad curve and project strongly upwards and forwards till they pass over the periphery. The siphuncle is situated close to the dorsal (inner) margin of the septa. No remains of the test are preserved in either of the specimens in the British Museum, nor was it known to d'Archiac.

Remarks. This species, as remarked by d'Archiac, bears some resemblance to *Nautilus triangularis*, Moutfort, from the Lower Chalk of England, and the Craie Chloritée of France, but it is distinguished from the latter by its more flexuous sutures and open umbilicus.

This species is among the fossils characterized by Blanford as the most important as well as the most abundant of the Ranikot group.

D'Archiac notes in his observations on this species that Carter's *Nautilus major* may very well be referred to the present species, and indeed Carter admits that his species is identical with d'Archiac's¹.

Of d'Archiac's figures of the present species it is impossible to speak in terms of commendation; they do not in fact bear out the description. The sutures do not exhibit the strong inflexion on the sides of the shell, near the umbilicus, which is so highly characteristic a feature of the species, and but for the remarkably angular periphery as depicted in fig. 2*a* it would have been impossible to recognize the fossil from the figures of it.

The largest specimen in the Collection (No. 36941), a remarkably fine one, has a maximum diameter of 11 inches.

Horizon. Ranikot Group² (Lower Eocene?).

Locality. Sind, India.

Represented in the Collection by two specimens (Nos. 36941 and 36942), which were presented by Colonel Sykes.

¹ Summary of the Geology of India, in Geological Papers on Western India, &c., edited by H. J. Carter, 1857, p. 700 (footnote).

² This is the name of the lowest Tertiary subdivision of the geological formations occurring in Western Sind and is derived from that of a hill-fortress of the Sind Amirs, situated in the Laki range of hills. The lower, which includes the greater portion of the Ranikot group, consists of soft sandstones, shales, and clays, probably of fluvatile origin. Towards the top, however, the beds consist of highly fossiliferous marine limestone, often light or dark-brown in colour, interstratified with sandstones, shales, clays, and ferruginous bands. These are the lowest beds in Sind, containing a distinctly Tertiary marine fauna. The Cephalopoda recognized in the Ranikot group are the following:—*Nautilus sub-Fleuriausianus*, d'Archiac, *N. Deluci*, d'Arch., and *N. Forbesi*, d'Arch. (W. T. Blanford, Geology of Western Sind, Mem. Geol. Surv. India, vol. xvii. 1880.)

A Table of the distribution of the fossils described by d'Archiac and Haine (in their work entitled 'Descr. des Anim. Foss. du Groupe Nummulitique de l'Inde,' 1853-4) in the different Tertiary and Infra-Tertiary Groups of Sind was prepared by Mr. F. Fedden, of the Geological Survey of India, and published in Mr. Blanford's report above cited (p. 198).

Mr. Fedden remarks that "it had hitherto been impossible, as has been

***Nautilus Labechei*, d'Archiac and Haime.**

1854. *Nautilus Labechei*, d'Archiac and Haime, Description des Animaux Fossiles du Groupe Nummulitique de l'Inde, livr. ii. p. 338, pl. xxxiv. ff. 13, 13 a, 13 b.
1854. *Nautilus minor*, Carter, Summary of the Geology of India, between the Ganges, the Indus, and Cape Comorin, Journal of the Bombay Branch of the Royal Asiatic Society, vol. v. p. 254.
1857. *Nautilus Labechei*, Carter, *ibid.*, reprinted with "Footnotes," in "Geological Papers on Western India, &c.," edited by H. J. Carter, p. 700 (foot-note).
- ? 1875. *Nautilus Labechei*, Owen, "On Fossil Evidences of a Sirenian Mammal from the Nummulitic Eocene of the Mokattam Cliffs, near Cairo," Quart. Journ. Geol. Soc. vol. xxxi. p. 103.
1880. *Nautilus Labechei*, Fedden and Blanford, Mem. Geol. Surv. of India, vol. xvii. p. 210.
1890. *Nautilus Labechei*, Foord and G. C. Crick, Ann. Mag. Nat. Hist. ser. 6, vol. v. p. 391.

Sp. Char. Shell (cast) rapidly expanding, subglobose, the sides slightly flattened, the periphery broadly rounded; greatest width in the umbilical region. Umbilicus very small; perhaps closed when the shell is present. Septa approximate; sutures very slightly waved. Siphuncle situated close to the dorsal (inner) margin of the septa.

Remarks. This species somewhat resembles the *Nautilus centralis* of J. Sowerby, from the London Clay, but the septa are closer together, and the siphuncle is differently situated. The present species is represented in the British Museum by two specimens (No. 36943), one of which, a body-chamber, with two septa attached, shows the position of the siphuncle.

Horizon. Lower Eocene?

Locality. Sind, India.

Represented in the Collection by two examples.

shown in the preceding paper (Mr. Blanford's) on the Geology of Sind, to tell from which particular horizon the fossils described by d'Archiac and Haime were obtained. It now appears that, instead of these fossils being exclusively Eocene, some are older and many newer, a large proportion being Miocene."

Mr. Fedden adds that his list is by no means complete, and that there are many new species yet to be described and named.

As we are concerned only with the Cephalopoda, it will suffice to say that all the species at present recognized, viz. *Nautilus sub-Fleuriausianus*, d'Archiac, *N. Deluci*, d'Arch., *N. Labechei*, d'Arch. and Haime, and *N. Forbesi*, d'Arch. and Haime, are from the Ranikot Group, which is supposed to be of Lower Eocene age; with one exception, *N. Labechei*, which is put down as ranging from the Cretaceous to the Lower Eocene.

***Nautilus Mokattamensis*, Foord.**

1867. *Nautilus imperialis*, Fraas, Aus dem Orient, p. 119. (Not of J. Sowerby.)

1875. *Nautilus Forbesi*, Owen, "On Fossil Evidences of a Sirenian Mammal from the Nummulitic Eocene of the Mokattam Cliffs, near Cairo," Quart. Journ. Geol. Soc. vol. xxxi. p. 103. (Not of d'Archiac and Haime.)

Sp. Char. Shell (cast) inflated, somewhat compressed on the sides, rather narrowly rounded on the periphery. Aperture very wide, semi-lunate. Umbilicus small, with steep sides. Septa approximate. Sutures flexuous, forming a conspicuous forwardly-directed lobe in the umbilical region, then curved backwards in a broad and shallow sinus, and again a little forwards, and making a narrow but distinct sinus on the periphery. The position of the siphuncle is not seen. None of the test is present.

Remarks. This species resembles *Nautilus imperialis*, J. Sow., in the form of the sutures and the umbilicus, but the periphery is narrower and the aperture much broader than in Sowerby's species.

The assignment of this species to *Nautilus Forbesi*, d'Archiac and Haime, does not appear to be justified by the description and figures given of the latter¹. The description is not very complete, but the figures, if correct, represent a much narrower and more compressed shell than the one under consideration, the only point of resemblance between the two being the form of the sutures. It was thought better therefore to bestow a new name upon the Egyptian form, rather than to merge it in the Indian one, with which it does not seem to be clearly connected.

Horizon. Eocene.

Localities. Mokattam escarpment², near Cairo. Egypt?

Represented in the Collection by two fragments, one of which (No. 3404) was presented by Sir R. Owen, K.C.B.; the other (No. 3403) was transferred from the Museum of Practical Geology.

¹ Descrip. des Anim. Foss. du Groupe Nummulitique de l'Inde, livr. ii. p. 338, pl. xxxiv. ff. 12, 12 a.

² "The Mokattam escarpment forms a long connected line of cliff, for the most part nearly inaccessible in front, but which can be easily ascended from some of the numerous lateral ravines . . . The height is probably about 800 feet above the Nile . . . The beds are almost flat, having but a slight dip towards the desert. In a northerly direction the hill diminishes rapidly in height until it is covered by the red quartzose millstone-rock of Jebel Achmar.

"Apart from palæontological considerations, the Nummulitic escarpment,

Nautilus, sp.

Several worn fragments of a small *Nautilus*, too imperfect for specific determination, may be thus briefly described:—Shell inflated, rapidly expanding, very slightly flattened on the sides, broadly rounded on the periphery. Umbilicus open, with steep sides. Septa approximate, very slightly flexuous on the sides, nearly straight in crossing the periphery. Body-chamber, siphuncle, and test unknown.

The specimens described were collected by Mr. W. K. Loftus in the "Nummulitic Series" of Tertiary Rocks (Eocene?) on the Turko-Persian frontier¹. The deposit containing them is thus described by Mr. Loftus:—"Yellowish calcareous marl, abounding with fossils; the lower part with *Alveolina subpyrenaica* in particular. The number of fossils procured from this bed (No. 6 of the Kirrind limestone) was between 70 and 80 species. This bed does not exceed 30 feet in thickness. The lower portion being more argillaceous than the upper, the fossils, chiefly *Nummulites Biaritzensis* and *Alveolina subpyrenaica*, are easily detached."

Other fossils were also found in this bed in great numbers, chiefly molluscs, but also Echinoderms, Crustacea, and a few fragments of fish-remains.

Horizon. Tertiary (Eocene?).

Locality. Kirrind, Persia.

Nautilus decipiens, Michelotti.

1861. *Nautilus decipiens*, Michelotti, Études sur le Miocène Inférieur de l'Italie Septentrionale, p. 137, pl. xiii. f. 11.
 1872. *Nautilus decipiens*, Bellardi, I Molluschi dei Terreni Terziari del Piemonte e della Liguria, pt. i. p. 21.
 1889. *Nautilus decipiens*, Benoist, Coquilles Fossiles des Terrains Tertiaires Moyens du Sud-ouest de la France, Actes de la Soc.

owing to a well-marked physical division, may be divided into two parts, the white and the brown beds, the latter being the higher member of the group. The lower, or white beds, are said by Dr. Figari Bey (Studi scientifici sull'Egitto, vol. i. p. 136) to rest upon tufaceous and slightly argillaceous limestone, representing the upper part of the Cretaceous formation." ("On the occurrence of Celestine in the Nummulitic Limestone of Egypt." By H. Bauerman and C. Le Neve Foster, Quart. Journ. Geol. Soc. vol. xxv. 1869, p. 40.)

¹ "On the Geology of the Turko-Persian Frontier, and of the Districts adjoining," by W. K. Loftus (Quart. Journ. Geol. Soc. 1855, vol. xi. p. 247).

Linnéenne de Bordeaux, sér. 5, vol. ii. livr. i. p. 17, pl. i. ff. 2 a, 2 b.

Sp. Char. "Shell discoid, compressed, back rounded; septa distant from one another, slightly undulated and sinuous; aperture longer than wide; umbilicus very contracted." (*Michelotti*.)

Remarks. The specimens in the British Museum agree so well with the figure and description of *Nautilus decipiens* that there seems to be ample justification for referring them thereto. Both the specimens are casts, but they exhibit the general form of the shell as described by Michelotti—the small umbilicus and the widely spaced, slightly flexuous septa.

One of them (No. C. 490) exhibits three or four distant, strong, transverse plications on the periphery, extending a little way down the sides of the shell; the test would appear therefore to have been coarsely ribbed. These ornaments (if such they be) are not referred to by Michelotti.

In a report by Edward Forbes on a collection of Tertiary fossils from Malta and Gozo, collected by Lieut. Spratt, R.N.¹, mention is made of "Two species of *Nautilus*, one of which is the *Nautilus zigzag* identical with the London Clay fossil."

Dr. Leith Adams², in a paper read before the Geological Society, refers to the "fragments of a *Nautilus*" having been found in the Marl beds of Malta, and in a later communication to the same Society³ he mentions "casts of *Nautilus*" from the Marl bed.

Horizon. Miocene.

Locality. Malta.

Represented in the Collection by two examples.

Nautilus Allioni, Michelotti.

1840. *Nautilus Allioni*, Michelotti, Cefalopodi Fossili, p. 1.

1842. *Nautilus umbilicatus*, Sismonda, Synopsis Methodica Animalium Invertebratorum Pedemontii Fossilium, p. 44. (*Not of Lamarck.*)

1847. *Nautilus excavatus*, Sismonda, *ibid.* 2nd ed. p. 58.

¹ Proceed. Geol. Soc. 1844, vol. iv. pt. ii. p. 231.

² "On the Fossil Echinidæ of Malta, by Thomas Wright; with additional Notes on the Miocene Beds of the Island and the Stratigraphical Distribution of the Species therein, by A. Leith Adams" (Quart. Journ. Geol. Soc. 1864, vol. xx. p. 472).

³ Quart. Journ. Geol. Soc. 1879, vol. xxxv. p. 519.

1847. *Nautilus Allioni*, Michelotti, Description des Fossiles des Terrains Miocènes de l'Italie Septentrionale, pp. 347, 402, pl. xv. f. 1.
 1852. *Nautilus Allioni*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. iii. p. 25.
 1852. *Nautilus Michelottii*, d'Orbigny, ibid. p. 25.
 1872. *Nautilus Allionii*, Bellardi, I Molluschi dei Terreni Terziari del Piemonte e della Liguria, pt. i. p. 20, tav. iii. ff. 1, a-d.
 1889. *Nautilus Allionii*, Benoist, Coquilles Fossiles des Terrains Tertiaires Moyens du Sud-ouest de la France, Actes de la Soc. Linnéenne de Bordeaux, sér. 5, vol. ii. livr. i. p. 17, pl. i. ff. 3 a, 3 b.

Sp. Char. Shell moderately inflated, compressed on the sides, rather broadly rounded on the periphery; umbilicus open, small; septa rather distant, sutures slightly flexuous on the sides, but passing over the periphery without any perceptible sinuosity. Siphuncle situated nearly in the centre of the septa. Test smooth.

Remarks. The specimen which I have referred to this species, with some measure of doubt, is a cast of three chambers of a rather large specimen. It is much distorted, so that it appears wider than it would otherwise be. It measures 3 inches in its greatest diameter by about $3\frac{1}{2}$ inches wide; but the width is considerably increased by the vertical pressure that the specimen has undergone.

Horizon. Miocene.

Locality. Malta.

Represented by a single example (No. C. 3363), which was presented by John Murray, Esq., LL.D., Ph.D.

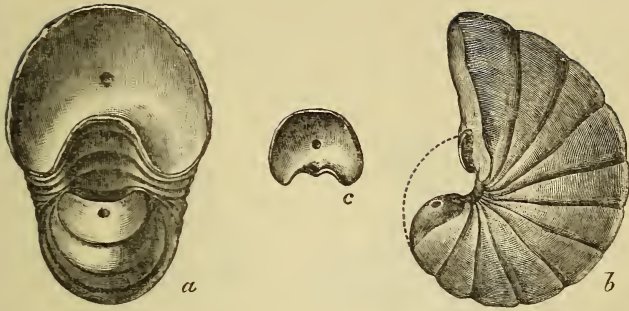
***Nautilus Geelongensis*, Foord.**

Sp. Char. A number of detached casts of the chambers which, when fitted together, make up a shell of a somewhat inflated form, rather compressed on the sides, and broadly rounded upon the periphery. The aperture would be considerably wider than high. The septa are moderately distant, the sutures very slightly flexuous, with a dorsal lobe in the young shell (fig. 69, c). The siphuncle is nearly central, perhaps a little below the centre. Not a vestige of the shell remains.

Remarks. This species resembles *Nautilus regalis*, J. Sow., in its somewhat laterally compressed whorls and the position of the siphuncle; but it is a more inflated shell than Sowerby's, and its sutures much less flexuous.

I can find no account of any *Nautilus* (properly so called) in the

Fig. 69.



Nautilus Geelongensis.—*a*, front view, showing the position of the siphuncle ; *b*, lateral view ; *c*, a detached septum, showing the dorsal lobe of the sutures in the young shell. Drawn from a specimen (No. C. 1568) in the British Museum. About one third natural size.

Australian Tertiaries ; apparently the only Cephalopod recorded from them being the *Aturia australis*, M'Coy¹.

Horizon. Miocene ?

Locality. Near Geelong (Victoria), Australia.

***Nautilus (Hercoglossa) Cassinianus*, Foord and
G. C. Crick².**

1890. *Nautilus (Hercoglossa) Cassinianus*, Foord and G. C. Crick,
Ann. Mag. Nat. Hist. ser. 6, vol. v. p. 408, f. 9.

Sp. Char. Shell compressed, with flattened sides and narrowly rounded periphery. Greatest thickness in the region of the umbilicus ; the latter closed. Septa approximate, sutures forming a sharply bent, forwardly-directed lobe after leaving the umbilicus, then bent backwards in a similar lobe, and finally directed forwards towards the periphery, which they cross with a narrow arch. Siphuncle situated below the centre.

Remarks. This species closely resembles *Nautilus (Hercoglossa) Danicus*, but is easily distinguished by its more compressed whorls and the position of its siphuncle. It may be added that the close

¹ Geol. Surv. of Victoria, Rep. of Progress, 1874, p. 36. Also Prodr. of the Palæont. of Victoria, decade iii. 1876, p. 21, pl. xxiv. ff. 1-5.

² *Aturia Cassiniana*, Edwards, MS.

proximity of these species in the geological series (*N. (H.) Danicus* from the uppermost beds of the Chalk, and *N. (H.) Cassinianus* from from the Lower Eocene) renders their near relationship highly probable.

Fig. 70.



Nautilus (Hercoglossa) Cassinianus.—*a*, lateral view of a fragment, showing the curvature of the sutures; *b*, front view, showing the position of the siphuncle. Drawn from a specimen in the British Museum (No. 71003). Natural size.

The name of this species is taken from a list of the Edwards Collection of Fossils now in the British Museum, but the species was never described. Edwards erroneously placed it in the genus *Aturia*.

Horizon. London Clay (Lower Eocene).

Localities. Finchley, Middlesex (Edwards's type); Isle of Sheppey.

Represented in the Collection by two specimens.

***Nautilus (Hercoglossa) Ægyptiacus*, Foord.**

Sp. Char. Shell (cast, No. 70378) inflated, very convex on the sides, but having a very narrowly rounded, almost subangular periphery. The umbilicus appears to be closed. The septa are rather wide apart, those seen being $1\frac{1}{3}$ inches distant from each other on the periphery, where the height of the whorl is from $2\frac{3}{4}$ to 3 inches. The sutures form two very distinct lobes of equal size, one of which is directed forwards on the middle of the sides, and the other bends backwards between the first lobe and the umbilicus; the sutures are nearly straight in crossing the periphery. The test is not preserved.

Remarks. In its inflated sides and subangular periphery this species bears some resemblance to *Nautilus Rollandi*, Leymerie (Mém. Soc. Géol. de France, sér. 2, 1844, vol. i. pt. i. p. 365, pl. xvii. f. 1, two figs.); but the sutures of the latter, though very flexuous, are not lobed. Leymerie's specimen, which is a cast,

was derived from the "Terrain Nummulitique" of the Montagne Noire (Aude).

Horizon. Eocene.

Locality. Mokattam escarpment, near Cairo.

Represented in the Collection by a specimen presented by Sir R. Owen, K.C.B.

Genus **ATURIA**, Bronn ¹.

(*Nautilus*, J. Sowerby, 1812 ²; *Nautilus*, Basterot, 1825 ³; *Aganides*, d'Orbigny, 1825 ⁴; *Ammonites*, Van Mons, 1834 ⁵; *Nautilus*, v. Buch, 1834 ⁶; *Aganites* (pars), Quenstedt, 1840 ⁷; *Aganides*, Pictet, 1845 ⁸; *Clymenia*, Michelotti, 1847 ⁹; *Nautilus*, Sismonda, 1847 ¹⁰; *Aganites* (pars), Quenstedt, 1849 ¹¹; *Clymenia*?, Dixon, 1850 ¹²; *Nautilus*, Sæmann, 1852 ¹³; *Megasiphonia*, d'Orbigny, 1852 ¹⁴; *Nautilus*, Morris, 1854 ¹⁵; *Nautilus*, Schafhäütl, 1863 ¹⁶; *Nautilus*, Fuchs, 1876 ¹⁷; *Nautilus*, Abich, 1882 ¹⁸.)

Gen. Char. *Aturia* was thus briefly defined by Bronn in the 2nd edition of the 'Lethæa Geognostica' (Band ii. 1838, p. 1123):—"The siphuncle subcentral [*i. e.* subdorsal]; the septa with a deep, narrow,

¹ Lethæa Geognostica, Band ii. 1838, pp. 1122, 1123. The name *Aturia* (*Aturus* or *Adurus* of the Romans) is derived from that of the River Adour (Landes, France), which, in its turn, is taken from the radical Celtic *dour*, water.

² Min. Conch. vol. i. p. 12.

³ Descr. Géol. du Bassin Tertiaire du Sud-ouest de la France, pt. i., Mém. de la Soc. d'Hist. Nat. de Paris, p. 17.

⁴ Tabl. des Céphalopodes, p. 71.

⁵ Bull. de l'Acad. de Bruxelles, vol. i. p. 113.

⁶ Neues Jahrbuch für Min. &c. p. 534.

⁷ Ibid. p. 289.

⁸ Traité de Paléontologie, vol. ii. p. 341.

⁹ Descr. des Foss. des Terr. Miocènes de l'Italie Septentrionale, p. 349.

¹⁰ Ibid. p. 346.

¹¹ Die Cephalopoden, p. 58.

¹² Geology and Fossils of the Tertiary and Cretaceous Formations of Sussex, pp. 110, 194.

¹³ Palæontographica, Band iii. Lief. iii. p. 141.

¹⁴ Prodr. de Paléont. Stratigr. vol. iii. p. 25.

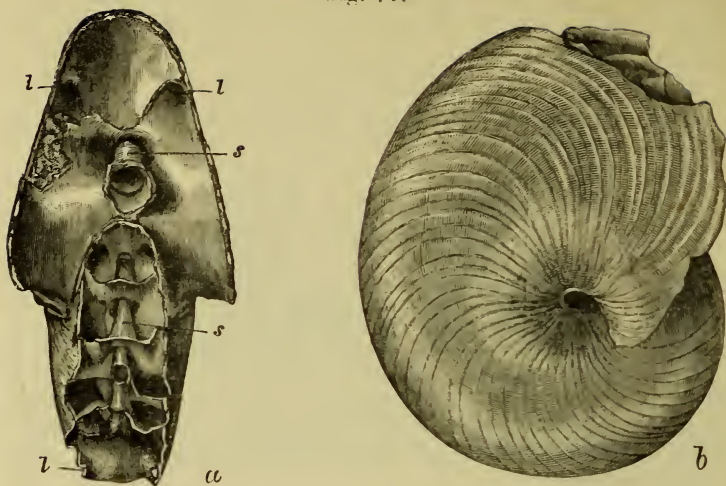
¹⁵ Cat. of British Fossils, 2nd ed. p. 306.

¹⁶ Süd-Bayerns Leth. Geogn. pp. 217, 281.

¹⁷ Sitzungsber. d. k. Akad. d. Wissensch., math.-naturwiss. Classe, Band lxxiii. p. 68.

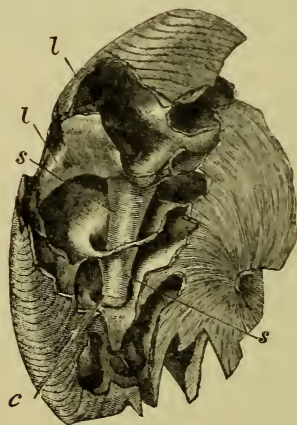
¹⁸ Geologie des Armenischen Hochlandes, p. 298.

Fig. 71.



Aturia Aturi.—*a*, front view of a specimen (No. 36838) partly broken open, showing *l. l. l.*, orifices of the lateral lobes of the septa; *s s.*, siphuncle: *b*, lateral view of the variety *australis* (No. C. 1548), showing the closed umbilicus and the fine lines of growth. Drawn from specimens in the British Museum. *a* is reduced to about two thirds of the natural size; *b* is nearly full size.

Fig. 72.



Aturia Aturi.—Periphero-lateral view of part of the interior of the same specimen as that represented in Fig. 71, *a*, showing *l. l.*, lobes of the septa (those on the right-hand side of the figure are broken off), *s, s.*, necks of the septa, forming the calcareous funnel-shaped invaginated sheaths in which the fleshy siphuncle was contained; *c*, swollen band or collar at the entrance of the funnel. The figure is about two thirds natural size.

lancet-shaped lobe on each side." In the 3rd (enlarged) edition (Band iii. 1856, p. 595) he describes the siphuncle as nothing more than a funnel-like prolongation of the septa, the extremity of which penetrates deeply into the immediately preceding funnel, with the interior of which it is united, being thickened at the point of junction. From the strong contraction of the siphuncle it follows that, although its aperture rests on the edge of the septa, its narrow extremity is not in contact with the shell-wall. In this respect the siphuncle of *Aturia* differs from that of *Clymenia* and the Ammonites.

Aturia may now be defined as follows:—Shell Nautilus-like, compressed, completely involute, non-umbilicated. Septa numerous, with an angular lobe on each side, directed backwards, and abutting against the shell-wall (fig. 72, *l*); the dorsal part of the septa prolonged backwards and forming a large, marginal, funnel-shaped siphuncle (fig. 72, *s*).

Type, *Nautilus Aturi*, Basterot¹.

Eocene to Miocene.

Remarks. The remarkable feature in the siphuncle of *Aturia* is the great length of the septal necks. These form a series of invaginated funnels² which are slightly constricted at their narrower or posterior extremity, just after they emerge from the mouth or opening of the preceding neck; at which point they form a swollen band or collar (fig. 72, *c*), on or a little posterior to which there is a suture line, which marks the commencement of the nacreous layer at its narrow end, or, in other words, the beginning of a new septal neck. The "couche jaune," which will be called in future the yellow layer, spreads over the whole of the internal wall of the siphuncle, and is separated from the thick nacreous shell by a porous layer, about to be described. The surface of the yellow layer is smooth, or very slightly rugose in places. On removing portions of the thick nacreous layer (fig. 73, *b, b* & *c, c*) a porous layer³ is seen (fig. 73, *e, e* & *g, g*), which is thickest at or near

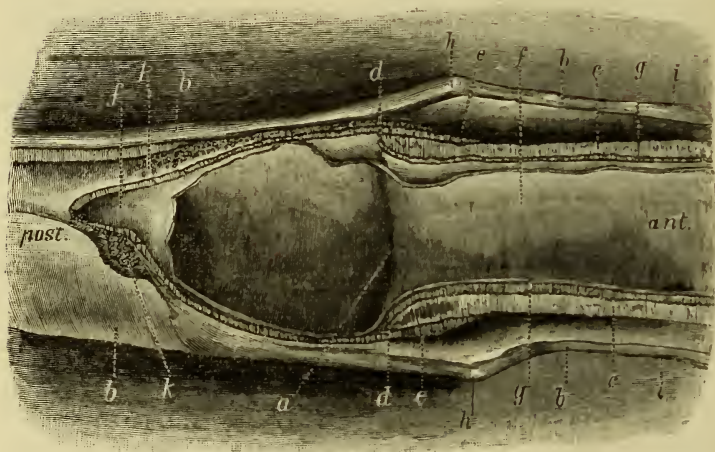
¹ "Descrip. des Coquilles Fossiles des Environs de Bordeaux," Mém. de la Soc. d'Hist. Nat. de Paris, vol. ii. 1825, pt. i. p. 17.

² The term "funnel" is not employed here in a technical sense, but only as expressing the form of these prolongations of the septa. In a strict sense they will always be called "necks," the English equivalent of the French term "goulots," and of the German "Siphonaldüten" or "Septaldüten."

³ A similar layer to this one was described in *Nautilus pompilius* by Quenstedt as "porösen Kalksinterschicht" ('Die Cephalopoden,' 1849, p. 23); by Valenciennes under the name of *mucoso-calcaire* (Barrande misquotes the last word

the suture line above mentioned, and helps to produce the swollen band or collar at this point (fig. 72, c). This porous layer had, according to Barrande¹, a very wide superficial extension. That

Fig. 73.



Aturia Aturi — Enlarged representation of part of two of the invaginated septal necks, broken open, showing the different layers of which the siphuncle is composed. *a*, fold, where the new neck (invaginated within the preceding one) begins: this fold marks the position of the suture line, described elsewhere in the text; *b, b*, nacreous layer of the older neck; *c, c*, nacreous layer of the newer neck; *d, d*, its commencement; *e, e*, porous layer, which forms a lining between the nacreous layer *b, b* and *f, f*, the yellow layer ("couche jaune" of Barrande), which covers the interior, and is regarded by Barrande as representing the corneous layer investing the fleshy siphuncle in the recent *Nautilus*; *g, g*, porous layer of newer neck. The projections *h, h* represent, approximately, the greatest expansion of the neck anteriorly; *i, i*, broken line of the older neck; *k, k*, continuation of the porous layer, showing its granular surface.

"crétacée") (Extrait des Archiv. du Mus. d'Hist. Nat., Paris, 1839, p. 306); and by the brothers Sandberger as "Sinterröhre" (Die Verstein. Nassau, 1852, p. 140). All these authors are referred to by Barrande, who translates their observations (Syst. Sil. de la Bohême, vol. ii. pt. i.; texte, pt. iv. 1877, p. 336). More recently, Mr. Henry Brooks has described the structure of the siphuncle and necks of *N. pompilius*, and found that the "porous layer" is composed of "slender transparent sticks of calcareous matter" . . . "held together in bundles by organic matter" (Proceed. Boston Soc. Nat. Hist. vol. xxiii. 1888, p. 380, pls. i., ii.).

¹ Syst. Sil. de la Bohême, vol. ii. pt. i.; texte, pt. iv. 1877, chap. ix., "Définition et structure du Siphon dans les Nautilides," pp. 341-346.

author calls it "la couche de sédiment calcaire," and states that it covered the entire surface of the septa, and even the internal wall of the shell. I am not able either to verify or to deny this assertion from the specimens at my disposal, but there are indications in some specimens (see No. 34414) of its having been distributed beyond the limits of the septal necks. At any rate, it lined not only the interior of the siphuncle between the nacreous layer (fig. 73, *b, b*) and the yellow layer (fig. 73, *f, f*), but extended for a little distance, though in a greatly attenuated state, along the surface of the septal necks, where these open out into the chambers (fig. 72, *s, s*)¹. In Barrande's ideal section of *Aturia Aturi*² the porous layer of the newly formed septal neck is figured, and described as bifurcating with the porous layer of the older neck immediately preceding it. This, I think, is an error; I am not sure that they even touch each other, though I have represented them as doing so in the figure (fig. 73, lower part of figure, to the left of the letter *d*). It seems more than probable that at this point, where the new neck began to be formed, there was an interruption of growth, the different layers composing it being at their commencement nearly at right angles to the older layers (fig. 73, near the part lettered *d*).

The porous layer in *Aturia* is described by Hyatt in his well-known paper on the Embryology of Fossil Cephalopods³, and he regards the swollen band as being "though narrow, the representative of the external sheath of the siphon in *Nautilus pompilius*."

Edwards⁴ also, in describing *Aturia ziczac*, recognized the porous layer, which he described as a "soft, friable, calcareous sheath, which commences near the extremity of the funnel [neck], where it touches the preceding funnel, and extends to the end of the preceding funnel, to the interior surface of which it forms a sheath."

Barrande⁵ made a careful comparison between the different layers composing the siphuncle in *Aturia Aturi*, as above described, and

¹ The general absence of all trace of this porous layer beyond the region of the swollen band may be accounted for by removal in the process of fossilization, or by weathering, its extreme tenuity rendering it peculiarly liable to destruction.

² Syst. Sil. de la Bohême, vol. ii. pt. i., Atlas, pl. cccclxxix.

³ Bull. Mus. Zool. Cambridge, Mass., 1872, vol. iii. No. 5, p. 95.

⁴ Mon. Eocene Mollusca and Univalves of England, vol. i. 1849 (Mon. Pal. Soc.), p. 54.

⁵ Syst. Sil. de la Bohême, vol. ii. pt. 1; texte, pt. iv. 1877, pp. 338-346; Atlas, pl. cccclxxix.

those of *Nautilus pompilius*. He found four layers in each (beginning with the outside layer) as follows :--

Aturia Aturi.

1. External layer of calcareous deposit (= "porous layer" of my descriptions).
2. Nacreous layer, constituting the principal part of the neck.
3. Internal layer of calcareous deposit.
4. Internal yellow layer ("couche jaune"), applied to the previous layer (3).

Nautilus pompilius.

1. External calcareous layer.
2. Principal nacreous layer.
3. Internal calcareous layer.
4. Black corneous layer lining the interior.

Barrande remarks that the first three of these envelopes are evidently identical in the two species compared, for the porous layers (couches sédimentaires) of *Nautilus Aturi* cannot be other than the porous layers ("mucoso-crétacées) of *Nautilus pompilius*, more or less changed by chemical reactions after the death of the animal.

The internal yellow layer ("couche jaune") certainly appears to represent by its position the black corneous layer in the interior of the siphuncle of *Nautilus pompilius*. But the difference between them is so great that they could not be identified if it were not for their exact agreement in position. The difference in their composition (the one being calcareous, the other corneous) is not easily accounted for; but it may have been connected with the firmer attachment of the animal of *Aturia* in its shell, as indicated by the septal lobes and large invaginated siphuncle contrasted with the very slender siphuncle of *Nautilus*¹.

It is further stated by Barrande that the structure and nature of the siphuncular elements in *Nautilus umbilicatus* appear to be identical with those of *N. pompilius*.

Finally, one may consider, he says, the siphuncle of the two living species of *Nautilus* (*N. pompilius* and *N. umbilicatus*) and the siphuncle of *Nautilus Aturi*, of the Miocene Beds, as presenting, fundamentally, the same structure. Barrande draws a parallel between the long necks, coexisting with an invaginated siphuncle in

¹ See *suprà*, pp. 110-112.

Aturia, and similar structures in *Endoceras*. Hyatt, however, who at first adhered to Barrande's views on this question, came to the conclusion, after further study of the siphuncle of *Aturia*, that the latter is related to the group of forms with short septal necks (Ellipchoanoida¹), in which the siphuncle is "completed by an intervening connective wall of distinct structure from the septal funnels [necks]"².

Edwards³, adopting the opinion of von Buch, that the position of the siphuncle is of primary importance in the classification of fossil Cephalopods, united *Aturia* with *Clymenia* in the family Clymenidæ. But the involute shell and the unique form of the sutures in *Aturia* sufficiently distinguish it from *Clymenia*. Moreover, there are no fossils met with linking together these two genera in the course of the vast period of time that elapsed between the Devonian and the Eocene. *Aturia* cannot therefore be regarded as the descendant of *Clymenia* merely on account of the dorsal position and invaginated structure of its siphuncle. It can be shown, in fact, with some degree of probability, that these features did not possess the importance usually attached to them. Thus, in the type specimen of *Nautilus* [*Aturia*] *Parkinsoni*, Edwards, there is an ordinary cylindrical siphuncle in a shell whose septal characters are distinctly those of an *Aturia*. The specimen in question is a fragment of a very large, most probably adult, shell (the height of the largest septum being about 9 inches), greatly surpassing in size any other shells hitherto assigned to *Aturia*. Hence one feels disposed to conclude that the funnel-shaped siphuncle⁴ in *Aturia* was replaced by a simple one, when a certain stage in the growth of the shell had been attained. A large specimen of *Aturia Parkinsoni* from the London Clay (Lower Eocene) of Colchester tends rather to confirm this view of the case; that is, so far as may be judged from the somewhat imperfect view of the siphuncle in the young shell, obtained by removing damaged portions of the outer whorl on one side of the specimen⁵. It must be admitted that the evidence

¹ This group embraces the Actinoceratidæ and most of the true Nautiloids, including *Nautilus*.

² "Genera of Foss. Ceph.," Proceed. Boston Soc. Nat. Hist. vol. xxii. 1883, p. 271.

³ Mon. Eocene Mollusca and Univalves of England, vol. i. 1849 (Mon. Pal. Soc.), p. 50.

⁴ Using this term in its widest application to include the necks of the septa and their component parts.

⁵ The latter operation was a difficult one owing to the tough and unyielding nature of the matrix (cement-stone) and the brittleness of the shell.

afforded by this specimen as to the characters of its siphuncle is not quite satisfactory; but the characters of the septa are so clearly those of *Aturia* that one feels justified in placing both this and Parkinson's type specimen at least provisionally in the present genus.

The sudden appearance in the Tertiary fauna of such a highly specialized form as *Aturia* is not a little remarkable, because at that time there was a comparative scarcity of Nautili, and such as did exist were of the ordinary type. But in spite of the singularity of the characters presented by the septa and siphuncle, there is no reason to doubt the close relationship between *Aturia* and the typical Nautili of the Eocene and of the present seas. If it should be found, upon examination of more perfect specimens, that *Aturia Parkinsoni* possessed a cylindrical (non-invaginated) siphuncle in all stages of growth, the species might then be regarded as a sub-genus of *Aturia*, allied to the latter by its septal characters, and forming a connecting-link (as suggested by Edwards) between *Nautilus* and *Aturia*.

***Aturia ziczac*, J. Sowerby, sp.**

1812. *Nautilus ziczac*, J. Sowerby, Min. Conch. vol. i. p. 12, pl. i. (lowest figure).
 1833. *Ammonites Wapperi*, Van Mons, L'Institut, p. 272.
 1834. *Ammonites Wapperi*, Van Mons, Bull. de l'Acad. de Bruxelles, vol. i. no. 17, pp. 113, 118.
 1834. *Nautilus lingulatus*, v. Buch, Neues Jahrbuch für Min. &c. p. 534 (footnote).
 ? 1834. *Nautilus Alabamensis*, Morton, Synopsis of the Organic Remains of the United States, p. 33, pl. xviii. f. 3.
 1836. *Nautilus ziczac*, Wetherell, London and Edinburgh Phil. Mag. and Journ. of Science, ser. iii. vol. ix. p. 465.
 1836. *Nautilus ziczac*, Buckland, Bridgewater Treatise—Geology and Mineralogy, vol. i. pp. 359, 360, vol. ii. p. 63, pl. xliii. ff. 3, 4.
 1837. *Nautilus zigzag*, Deshayes, Descr. des Coquilles Fossiles des Environs de Paris, vol. ii. p. 765, Atlas, pl. c. ff. 2, 3.
 1837. *Nautilus Deshayesi*, de Koninck, Descr. des Coquilles Fossiles de l'Argile de Basele, Boom, Schelle, &c. (Nouv. Mém. de l'Acad. de Bruxelles, vol. xi.), p. 5, pl. iv.
 1839. *Nautilus zigzag*, v. Buch, Ueber Goniatiten und Clymenien in Schlesien (Akad. d. Wissensch.), p. 158, pl. —. ff. 6, 7, not f. 8.
 1840. *Nautilus lingulatus*, Quenstedt, Neues Jahrbuch für Min. &c. p. 290, f. 7.
 1845. *Nautilus zigzag*, Nyst, Descr. des Coquilles et des Polypiers Fossiles des Terrains Tertiaires de la Belgique (Mémoires Couronnés et Mém. des Savants Etrangers, publiés par l'Acad. Roy. des

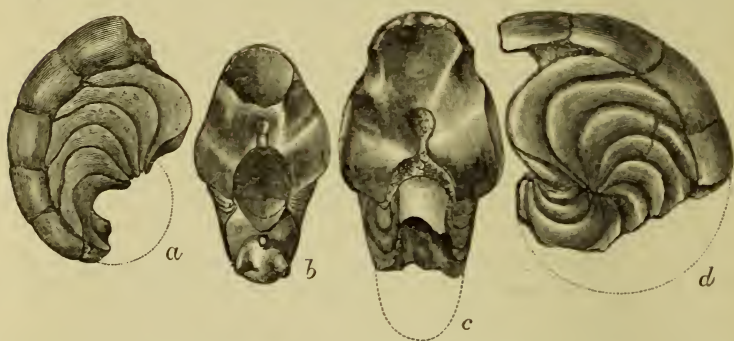
- Sciences et Belles-Lettres de Bruxelles, vol. xvii. 1843 et 1844), p. 614.
1847. *Nautilus ziczac*, Prestwich, "On the probable Age of the London Clay, &c.," Quart. Journ. Geol. Soc. vol. iii. p. 404.
1847. *Nautilus zigzag*, Geinitz, in Carus, Ueber die Auffindung von Ueberresten des *Basilosaurus* oder *Zygodon* (*Hydrachos*, von Koch), p. 2.
1849. *Nautilus lingulatus*, Quenstedt, Die Cephalopoden, p. 59, Taf. ii. f. 12.
1849. *Aturia ziczac*, Edwards, Monograph of the Eocene Mollusca, pt. i. Cephalopoda (Mon. Pal. Soc.), p. 52, pl. ix.
1850. *Nautilus?* (*Clymenia?*) *ziczac*, Dixon, Geology and Fossils of the Tertiary and Cretaceous Formations of Sussex, pp. 110, 194, pl. viii. f. 19.
1850. *Megasiphonia zigzag*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. ii. p. 338.
1850. *Megasiphonia Alabamensis*, d'Orbigny, *ibid.* p. 338.
1852. *Nautilus lingulatus*, Schafhäütl, Neues Jahrbuch für Min. &c. p. 164.
1854. *Nautilus ziczac*, Morris, Cat. of British Fossils, 2nd ed. p. 306.
1854. *Nautilus (Aturia) ziczac*, Prestwich, "On the Thickness of the London Clay, &c.," Quart. Journ. Geol. Soc. vol. x. p. 412.
1856. *Nautilus zigzag*, Bronn, Lethæa Geognostica, Aufl. iii. Band iii. Th. vi. p. 596.
1863. *Nautilus lingulatus*, Schafhäütl, Süd-Bayerns Lethæa Geognostica — Der Kressenberg und die südlich von ihm gelegenen Hochalpen, pp. 217, 281, Taf. liii. ff. 8, a, b.
1865. *Aturia ziczac*, Deshayes, Descr. des Animaux sans Vertèbres découverts dans le Bassin de Paris, vol. iii. (Suppl. to 'Descr. des Coq. Foss. des Environs de Paris'), p. 628.
- ? 1867. *Nautilus ziczac*, Fraas, Aus dem Orient, p. 125.
1872. *Nautilus (Aturia) ziczac*, Whitaker, Mem. Geol. Surv. of England and Wales, vol. iv. pt. i. Appendix, p. 589.
1877. *Nautilus Aturi*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i., Texte, pt. iv. pp. 207, 340; Atlas, pl. cccclxxix.
1882. *Nautilus ziczac*, Abich, Geologie des Armenischen Hochlandes, i. Westhälfte Geol. Forsch. in den Kaukasischen Ländern, Theil ii. p. 298, Taf. vi. ff. 2, 2 a, 2 b.
1884. *Aturia ziczac*, Zittel, Handbuch der Palæontologie, Band i. Abth. ii. Lief. iii. p. 384.
1884. *Aturia lingulatus*, Zittel, *ibid.* p. 384.
1887. *Aturia ziczac*, Geinitz, "Ueber *Nautilus Alabamensis*, Morton, *Nautilus ziczac*, Sowerby, und *Nautilus lingulatus*, v. Buch," Neues Jahrbuch für Min. &c. Band ii. p. 54.

Sp. Char. Shell subventricose, compressed, flattened on the sides, very narrowly rounded on the periphery; greatest width of the whorls in the umbilical region; umbilicus closed. Septa approxi-

mate; sutures strongly curved forwards on the sides, starting from the umbilicus, and then sweeping backwards and almost touching those of the preceding septum; they then bend forward again at a sharp angle, and continuing for a short distance in a direction parallel with that of the periphery, they pass over the latter at right angles to the last part of their course. The siphuncle is situated close to the dorsal margin. The test is quite smooth, having only very fine striæ of growth; in general only the nacreous layer is preserved.

Remarks. *Aturia ziczac* was first described by J. Sowerby from a specimen which was found during the construction of Highgate Archway. F. E. Edwards¹ describes it as "a smooth, involute shell,

Fig. 74.



Aturia ziczac.—*a*, lateral view of the specimen (No. 32650) figured in Dixon's 'Geology of Sussex,' pl. viii. f. 19; *b*, front view of the same; *c*, front view of a young specimen from Kressenberg, Bavaria (C. 2182); *d*, lateral view of the same. Drawn from specimens in the British Museum. All of the natural size.

more or less ventricose or depressed; the septa are outwardly deeply concave; and, owing to the regular curve in which the dorsal lobes are reflected towards the axis of the shell, they present, when viewed sideways, some resemblance to the letter S; the lateral lobes are more or less narrow, and taper rather suddenly towards the inferior extremity, which extends nearly to the preceding septum; but they are without the sinus which characterizes the lateral lobes of *Naut.* [*Aturia*] *Parkinsoni*. The English shells are generally either casts in, or filled with, pyrites. . . ."

¹ Monograph of the Eocene Mollusca, pt. i. Cephalopoda, Mon. Pal. Soc. pp. 52-55.

Edwards¹ separated the English examples of *Aturia ziczac* into two varieties, the first being J. Sowerby's *Nautilus ziczac*, and the second, which he called Variety β , Charlesworth's form. The latter he compared with the Dax shells, owing to its compressed whorls; the former with the "French, Belgian, and German shells," and, provisionally, the Piedmontese and Maltese shells also, making altogether a very diverse assemblage.

An interesting paper was published a few years ago by Dr. H. B. Geinitz² of Dresden, on *Nautilus Alabamensis*, Morton, *N. ziczac*, J. Sow., and *N. lingulatus*, v. Buch. The author gives his reasons for concluding that all these forms belong to one and the same species, viz. *Aturia ziczac*, J. Sowerby, sp. His attention was drawn to the subject by seeing a specimen in the Royal Mineralogical Museum at Dresden of the *Nautilus Alabamensis* of Morton, from the Tertiary rocks of Claiborne in Alabama. This species (well figured in the paper in question) was pronounced by v. Buch himself, in Dr. Geinitz's presence, to be "*Nautilus lingulatus*," v. Buch. After very carefully comparing a specimen of *Aturia ziczac* from Bracklesham (one of the typical localities) with a young specimen of the "*Nautilus lingulatus*" from Kressenberg, Bavaria, I have come to the same conclusion regarding them as Dr. Geinitz has done, viz., that the two species are identical. An examination of fig. 74 will, I think, convince anyone that this is the case. It will there be seen that in the form of the shells and of their sutures there is no appreciable difference between the two species; and I may add that my friend Mr. G. C. Crick had already referred the Kressenberg species to *Aturia ziczac*. Of course it is a little unfortunate that all the English shells belonging to the present species are immature; but there is no reason whatever for supposing that their form would become modified in any material degree when they attained adult age. It is just possible, indeed, that it may be a dwarfed or depauperated variety that we have in the London Clay of this country, but further evidence would be required to settle that point.

Horizon. London Clay (Lower Eocene).

Localities. Highgate, Chalk Farm, Hampstead; Middlesex: Sheppey.

The Collection includes Sowerby's type figured in the 'Mineral

¹ Mon. of the Eocene Mollusca, pt. i. Cephalopoda, 1849, Mon. Pal. Soc. pp. 54-56.

² Neues Jahrbuch für Min. &c. 1887, Band ii. p. 53.

Conchology,' and also the specimen figured in Dixon's 'Geology of Sussex.' The latter was figured also by Edwards in his 'Eocene Mollusca.' One of the specimens from Hampstead (No. C. 606) was presented by R. Maitland, Esq., and one from Sheppey (No. 39708) by Miss Wilson.

***Aturia Charlesworthi*, Foord.**

1837. *Nautilus ziczac*, Charlesworth, Mag. Nat. Hist. new series, vol. i. p. 533, f. 66 (woodcut).

1848. *Nautilus ziczac*, Mantell, 'Wonders of Geology,' 6th ed. vol. i. p. 247, woodcut 40, ff. 1, 2.

1849. *Aturia ziczac*, variety β , Edwards, Mon. of the Eocene Mollusca, pt. i. Cephalopoda (Mon. Pal. Soc.), p. 55.

Sp. Char. Shell (? young) compressed; sides very flat, periphery very narrowly rounded; umbilicus closed. Septa very approximate; thirteen in a complete whorl. Sutures resembling those of *A. ziczac*, but much closer together. Body-chamber unknown.

Remarks. This species was differentiated by Edwards from the "true *Naut. ziczac*, figured in 'Mineral Conchology'" (which he designated the "first variety" of *Aturia ziczac*), and placed by him in a second variety, β —the distinguishing characters of the latter being that "the shell is more compressed, almost discoidal; and consequently it is narrower on the ventral aspect; the dorsal lobes are not so broad, and the aperture is of a more elongated oval form."

Although there is only one example of the present species in the British Museum, the type specimen (No. 68918), its characters are so clearly distinct from those of *Aturia ziczac* that it seems justifiable to separate it from that species. In its compressed form *A. Charlesworthi* agrees closely with the Dax shells (*Aturia Aturi*), as remarked by Edwards; but on comparing it with small specimens of *A. Aturi* from Turin, I find that the septa are much more numerous in the English species, and the shell in the latter is more compressed even than that of any of the continental specimens of *A. Aturi*. The present species has been admirably figured by Charlesworth and Edwards. The figure given by the first of these authors is considerably enlarged, that of Edwards is of the natural size.

Horizon. London Clay (Lower Eocene).

Locality. Primrose Hill, London.

Represented in the Collection by the type specimen, first described by Charlesworth, and originally contained in Mr. Wetherell's Collection.

Aturia Parkinsoni, Edwards, sp.

1811. *Nautilite with sinuous diaphragms*, Parkinson, Organic Remains of a Former World, vol. iii. p. 105, pl. vii. f. 15.
1849. *Nautilus Parkinsoni*, Edwards, Mon. of the Eocene Mollusca, pt. i. Cephalopoda (Mon. Pal. Soc.), p. 49, pl. vii.
1872. *Nautilus Parkinsoni*, Whitaker, Geology of the London Basin; Mem. Geol. Surv. of England and Wales, vol. iv. pt. i. Appendix, p. 598.
1877. *Nautilus Parkinsoni*, Whitaker, The Geology of the Eastern End of Essex; Mem. Geol. Surv. of England and Wales (48 S.E.), p. 26.
- ? 1886. *Nautilus Parkinsoni*, Kaufmann, Beiträge zur geol. Karte der Schweiz, Lief. xxiv. p. 301.
1887. *Aturia Parkinsoni*, Geinitz, Ueber *Nautilus Alabamensis*, Morton, *Nautilus ziczac*, Sowerby, und *Nautilus lingulatus*, v. Buch; Neues Jahrbuch für Min. &c. Band ii. p. 56.

Sp. Char. Shell (cast) inflated, somewhat flattened on the sides and rather narrowly rounded on the periphery. Umbilicus closed. Septa approximate; sutures strongly arched forwards; lateral lobes broad, but ending in a narrow, bluntly pointed projection, which is separated from the broader portion by a slight constriction. Siphuncle large, situated nearly exactly halfway between the centre of the septum and the periphery of the preceding whorl. Test smooth. Body-chamber unknown.

Remarks. The specimen upon which the present species was founded consists of the casts of three very large chambers, admirably figured by Edwards, the plate being engraved by J. de Carle Sowerby, with his customary skill. In addition to the type specimen (No. 43869), the British Museum possesses another large one (from Colchester) (69571), which retains the test on one side, the other being much crushed. By removing part of the outer whorl on this side, the inner one has been exposed, and the siphuncle is thus laid bare in the younger part of the shell in two places. Here it is seen to be distinctly dorsal, the lower edge of its orifice almost touching the periphery of the preceding whorl. The siphuncle, as in the type specimen, appears to have been contained in a tubular sheath, which exhibits no tendency to expand into a funnel-like form between the septa, as is usually the case in *Aturia*. The Colchester specimen also shows that the siphuncle in *Aturia Parkinsoni* gradually shifted its position from the dorsal margin till it approached the centre of the septum; but whether it ever reached the centre cannot at present be determined. At any rate the Colchester specimen shows it in three different positions.

After describing the shell, sutures, &c. of the present fossil, Edwards says that the siphuncle is "moderately large, and is placed on the dorsal part of the septal disk, halfway between the centre and the margin." He adds, "So far as the general character can be ascertained, the siphuncle does not appear to differ from that of *Nautilus*, and certainly does not present any analogy with the wide trumpet-mouthed funnel which distinguishes *Aturia*."

The largest chamber in Parkinson's specimen measures 9 inches in height and 7 in breadth; and this chamber was not the last, and consequently not the largest in the entire shell.

Edwards thus relates the history of this remarkable fossil:—"Parkinson, in his work above cited [*'Organic Remains,'* 1811, p. 105], described the remains of a *Nautilus*, purchased by him at the sale of Dr. Menish's collection. These remains, which consist of three chambers, afterwards came into the possession of Mr. Sowerby, who has placed them at my service. Parkinson was ignorant of the locality whence they came; but from their mineralogical character, the matrix being, in fact, the substance known as cement-stone, it was supposed that they were found at Harwich. Lately the Rev. Thomas Image, of Whipstead, near Bury St. Edmunds, has forwarded to me for examination similar remains, unquestionably obtained at Harwich, and consisting of the casts of two chambers, rather smaller than those in Parkinson's specimen, and in a matrix precisely similar. The question, therefore, as to the locality of Parkinson's specimen is set at rest."

The sutures of this species bear a somewhat close resemblance to those of *Aturia Basteroti*, Benoist¹; but the siphuncle in the latter is described as even larger than that of *Aturia Aturi*, and its affinities are, on the whole, clearly not with the present species. Benoist's specimen, it may be mentioned, is large, the figures, which are half the natural size, measuring about 4 inches in their greatest diameter.

Further observations on this species are embodied in the description of the genus *Aturia* (*suprà*, p. 341).

Horizon. London Clay (Lower Eocene).

Localities. Harwich, Colchester; Essex.

Represented in the Collection by two specimens, the one from Harwich (No. 43869) in the "Sowerby Coll."

¹ Actes de la Soc. Linn. de Bordeaux, vol. xlii. Fév. 1889, sér. v. livr. i. p. 22; Atlas, livr. ii. Juin 1889, pl. ii. ff. 2 a, 2 b.

Aturia Delphinus, Forbes, sp.

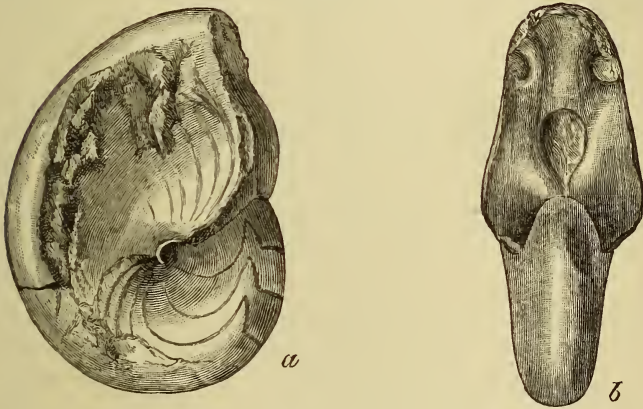
1846. *Nautilus Delphinus*, Forbes, Fossil Invertebrata from Southern India, Trans. Geol. Soc. ser. ii. vol. vii. p. 98 (woodcut, p. 99).

1850. *Megasiphonia Delphinus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. ii. p. 309.

1870. *Nautilus Danicus*, Stoliczka, Additional Observations regarding the Cephalopodous Fauna of the South-Indian Cretaceous Deposits; Records Geol. Surv. of India, vol. i. p. 32. (Not of Schlotheim.)

[Not 1861. *Nautilus Danicus*, Blanford, Mem. Geol. Surv. of India—Palæont. Indica—Foss. Ceph. Cret. Rocks of Southern India, p. 24, pl. x. ff. 4, 4 a, pl. xi.]

Fig. 75.



Aturia Delphinus.—*a*, lateral view, showing some of the sutures; *b*, front view, showing the large orifice of the siphuncle, and (above it) the openings of the septal lobes. Drawn from a specimen (No. 23282) in the British Museum. About two thirds natural size.

Sp. Char. "This species is much compressed, especially dorsally; the angles of the mouth project so as to give the aperture a hastate or triangular form. The surface of the only specimen is too much worn to be made out clearly. The septa are remarkably sinuous; laterally and nearly in the centre they make a bend, the sweep of which is abruptly curved and directed towards the umbilicus so as to form a sort of triangular lobe, resembling in form a porpoise's fin¹, and angulated at its superior base, whence the line crosses the back in a slightly undulated curve . . ." (*Forbes*.)

¹ Hence the name *Delphinus*.

Remarks. It is quite clear, from Forbes's description and figure of this species, that he was dealing with a species of *Aturia*, though he compared it with *Nautilus* [*Hercoglossa*] *sinuatus*, J. Sow. The fact that Forbes's specimen came from Pondicherry (having formed part of Messrs. Kaye and Cunliffe's Collection (1840) of Southern Indian fossils) is remarkable, because the rocks in the neighbourhood of Pondicherry are of Cretaceous Age¹, whereas the lowest horizon of *Aturia* in Europe and America is Lower Eocene. Stoliczka has added to the difficulty by confusing Forbes's species, *A. Delphinus*, with the *Nautilus* [*Hercoglossa*] *Danicus*, figured by Blanford ('Palæontologia Indica'²), which is a totally different fossil, as anyone may see by comparing the figures and descriptions of the two. Not only is the last named a highly inflated shell, but its sutures, instead of presenting the distinct lancet-shaped lobes characteristic of *Aturia*, and well shown in Forbes's figure, have the perfectly rounded outline of those of the typical forms of *Hercoglossa*. Moreover, in Forbes's figure the forwardly directed lobes of the sutures on the sides of the shell are nearly in the middle, whereas in *N.* [*H.*] *Danicus*, as figured by Blanford (*loc. cit.*), they are close to the umbilicus, on the inner fourth of the sides.

The specimen which I have referred to *A. Delphinus*, Forbes, sp., is from Kotri³ (Sind), where the Ranikot group (Lower Eocene) occurs. To the north-west of Kotri the brown limestones of this group are said to be well developed. The specimen, which is of a brown colour, has some hard matrix adhering to it, which is made up of comminuted fragments of shells, &c. It is somewhat crushed on one side and distorted, but the front aspect of it shows unmistakably the characteristic lobes and large siphuncular orifice of *Aturia*. The sutures are also seen, though faintly, on the sides of the shell, which retains the test in an altered condition.

The present species bears a close resemblance to the *Nautilus Aturi*, var. *Australis*, and it is difficult to point out in what respect they differ from each other. Until better specimens of the Indian form are forthcoming it may be best, however; to keep them separate.

¹ Dr. Stoliczka has proved that the general homotaxis of these beds is Middle and Upper Cretaceous, and that the Neocomian and Oolitic forms, which led to a portion of the beds being classed as "Lower Cretaceous, are less numerous than the Middle Cretaceous species with which they are associated. (Extract from Medlicott and Blanford's *Man. of India*, 1879, vol. i. p. 268.)

² *Mem. Geol. Surv. India*, 1861, p. 24, pl. x. ff. 4, 4 a.

³ Formerly written Kotree.

Horizon. Eocene.

Locality. Kotri (Sind), India.

Represented in the Collection by a single example (No. 23282).

Aturia Aturi, Basterot.

1802. *Nautilite de Dav*, Montfort, in his edition of "Suite à Buffon" (Hist. Nat. des Mollusques, An. x.), vol. iv. p. 240, pl. xlv. f. 1.
1822. *Nautilus pompilius* (pars), Lamarck, Hist. Nat. des Animaux sans Vertèbres, vol. vii. p. 634.
1825. *Nautilus Aturi*, Basterot, Descr. Géol. du Bassin Tertiaire du Sud-Ouest de la France, pt. i. Mém. de la Soc. d'Hist. Nat. de Paris, pp. 12, 17.
1825. *Nautilus Deshayesi*, Defrance, Dict. des Sciences Naturelles, vol. xxxiv. p. 300.
1834. *Nautilus Deshayesi*, de Koninck, Bull. Soc. Géol. de France, vol. iv. p. 437.
1837. *Nautilus Sypho*, Buckland, Bridgewater Treatise—Geology and Mineralogy, vol. i. pp. 357–360, vol. ii. p. 63, pl. xliii. ff. 1, 2.
1838. *Nautilus Aturi*, Bronn, Lethæa Geognostica, Band ii. p. 1123, Taf. xlii. f. 17, a–c.
1839. *Nautilus zigzag*, v. Buch, Ueber Goniatiten und Clymenien in Schlesien (Akad. d. Wissensch.), p. 159, pl. —. f. 8; *not* ff. 6, 7.
1840. *Clymenia zigzag*, Michelotti, Cefalopodi Fossili, p. 6, no. 1 (excl. synon.).
1840. *Nautilus Aturi*, Quenstedt, Neues Jahrbuch für Min. &c. p. 289.
1842. *Agonides zigzag*, E. Sismonda, Synop. Meth. Animalium Invertebratorum Pedemontii Fossilium, p. 44.
1842. *Nautilus pompilius*, E. Sismonda, *ibid.* p. 44. (*Not* of Linnæus.)
1843. *Nautilus zigzag*, d'Archiac, Descr. Géol. du Département de l'Aisne, vol. v. pt. ii. p. 404.
1844. *Nautilus zigzag*, Forbes, Report on the Collections of Tertiary Fossils from Malta and Gozo; Proceed. Geol. Soc. vol. iv. pt. ii. p. 231.
1845. *Nautilus sypho*, Grateloup, Bull. d'Hist. Nat. de la Soc. Linéenne de Bordeaux, vol. ii. 2nd ed. p. 22. (*Not* of Buckland.)
1845. *Agonides Aturi*, Pictet, Traité de Paléontologie, vol. ii. p. 341.
1847. *Clymenia Morrisi*, Michelotti, Descr. des Fossiles des Terrains Miocènes de l'Italie Septentrionale, p. 349.
1847. *Nautilus diluvii*, Sismonda, in Michelotti, *op. cit.* p. 346.
1849. *Aturia ziczac*, Edwards, Monograph of the Eocene Mollusca, pt. i. Cephalopoda (Mon. Pal. Soc.), pp. 54, 55, pl. ix. ff. 2, 3. (Dax specimens.)
1849. *Nautilus Aturi*, Quenstedt, Die Cephalopoden, p. 59, tab. ii. f. 11.
1852. *Nautilus ziczac*, Saemann, Ueber die Nautiliden, Palæontographica, Band iii. Lief. iii. p. 141, Taf. xxi. f. A.

1852. *Megasiphonia Aturi*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. iii. p. 25.
1856. *Aturia Aturi*, Bronn, Lethæa Geognostica, Band iii. p. 595.
- ? 1858. *Nautilus ziczac*, Ooster, Catalogue des Céphalopodes des Alpes Suisse, pt. iii. p. 16, tab. xii. f. 3.
1861. *Aturia Morrisii*, Michelotti, Études sur le Miocène Inférieur de l'Italie Septentrionale, p. 133.
1868. *Aturia (Nautilus) Aturi*, Dewalque, Prodr. d'une Description Géologique de la Belgique, p. 417.
1872. *Aturia Aturi*, Bellardi, I Molluschi dei Terreni Terziari del Piemonte e della Liguria, pt. i. p. 23.
1873. *Aturia Aturi*, Benoist, Cat. Test. Foss. La Brède-Saucats, p. 227, no. 800.
1874. *Nautilus ziczac*, Cornet and Briant, Aperçu sur la Géologie des Environs de Mons, Bull. Soc. Géol. de France, sér. iii. vol. ii. p. 537.
1875. *Nautilus (Aturia) Aturi*, Hoernes, Die Fauna des Schliers von Ottmang, Jahrbuch d. k. k. geol. Reichsanst. Band xxv. Heft iv. pp. 341, 344, Taf. xii. ff. 5, 6.
1876. *Nautilus Aturi*, Fuchs, Ueber den sogenannten "Badner Tegel" auf Malta; Sitzungsberichte der k. Akad. d. Wissenschaft. mathemat.-naturwiss. Classe, Band lxxiii. p. 68, Taf. i. ff. 8, 9.
1879. *Nautilus ziczac*, Leith Adams, On Remains of Mastodon and other Vertebrata of the Miocene Beds of the Maltese Islands, Quart. Journ. Geol. Soc. vol. xxxv. p. 519.
1880. *Aturia Aturi*, Tiberi, Cefalopodi, Pteropodi, Eteropodi viventi nel Mediterraneo e Fossili nel Terreno Terziario Italiano; Bull. Soc. Malac. Italiana, vol. vi. Fogli 1-4, p. 28.
1882. *Nautilus (Aturia) Aturi*, von Koenen, Die Gastropoda holostomata und tectibranchiata, Cephalopoda und Pteropoda des Norddeutschen Miocän, ii. Theil, von "Das Norddeutsche Miocän und seine Molluskenfauna;" Neues Jahrb. für Min. &c. Beilage Band ii. p. 353.
1884. *Aturia Aturi*, Zittel, Handbuch der Palæontologie, Band i. Abth. ii. Lief. iii. p. 384, f. 527.
1889. *Aturia Aturi*, Benoist, Coquilles Fossiles des Terrains Tertiaires Moyens du Sud-Ouest de la France, Actes de la Soc. Linnéenne de Bordeaux, vol. xlii. sér. v. livr. i. (Feb. 1889) p. 20, pl. ii. ff. 1 a, 1 b¹. (The plates are in livr. ii., June 1889.)

[See *suprà*, p. 336, figs. 71 a, 72, and p. 338, fig. 73.]

Sp. Char. Shell discoid, flattened; aperture subtriangular, higher than wide; strongly arched forwards at the sides and deeply emarginate on the periphery, the latter very narrowly rounded; greatest width of the whorls in the umbilical region. Umbilicus closed. Septa approximate, much curved, about thirteen in the last whorl;

¹ Erroneously printed on p. 20 "figs. 3 a, 3 b."

lobes oblique, lanceolate, elongate, extending nearly to the dorsal margin of the preceding whorl. Body-chamber deep, equalling $\frac{2}{3}$ of the last whorl. Segments of the siphuncle very rapidly expanding. Test thin, covered with very fine striæ, which are parallel with the edge of the aperture. Surface ornamented with semi-circular, transverse, approximate zones or bands of a reddish colour, beginning in the umbilical depression and extending to the edge of the periphery, upon which they break up into little patches which follow the direction of the striæ.

Remarks. This species has been regarded by many authors as equivalent to J. Sowerby's "*Nautilus ziczac*;" but a critical comparison of the two species shows that they are really quite distinct, the present species having a much more compressed shell than Sowerby's. Passing over the numerous references to *Aturia Aturi* in the works of English and Continental authors, many of which are enumerated at the head of this description, we find the most recent account of that species in a paper by M. E. A. Benoist, entitled "*Coquilles Fossiles des Terrains Tertiaires Moyens du Sud-Ouest de la France*"¹. This author restricts the species under discussion to those forms which have been derived from the Miocene of South-western France and of Italy, and, taking the Dax form as typical, this disposition of the species seems to hold good. There are still, however, some forms from other countries recorded, and sometimes figured, whose affinities it is difficult to determine without an appeal to the actual specimens; and even with that advantage a decision might be hazardous, owing to the fact that the specimens obtainable are often only fragmentary casts. In such a condition is that figured by Meneghini² under the name *Nautilus (Aturia) zig-ag*, Sow., and therefore I have omitted it from the list of references to the present species, though, so far as Meneghini's form can be made out from the figures, it may possibly belong to it. There is very great difficulty, however, in comparing these fragmentary casts with the Dax specimens, which are quite in the condition (save the loss of the animal matter in the shell) of recent shells. It may be mentioned that there is a large fragment of an *Aturia* in the Collection (No. 73358) (a cast consisting of four chambers) that bears a very close resemblance to the large fragment figured by Meneghini (*loc. cit.*), which it exactly equals in size. Meneghini's specimen is

¹ Actes de la Société Linnéenne de Bordeaux (Feb. 1889), vol. xlii. sér. v. livr. i. p. 20, pl. ii. ff. 1 a, 1 b.

² Paléontologie de l'Ile de Sardaigne, 1857 (pt. iii. of the 'Voyage en Sardaigne' of General La Marmora), p. 453, pl. H. ff. 2, 2'.

cited as "*Nautilus (Aturia) zigzag*," Sow. Whether it is the *Aturia Aturi* of Basterot, as exemplified in the Dax specimens, or some other species would be almost impossible to determine from such imperfect material. The British Museum specimen (No. 73358) is said to have come from the South of France. Some of my references to *Aturia Aturi* are, from the nature of the case, more or less doubtful. Among these are the citations from Defrance, d'Archiac, Pictet, Ooster, and others, especially where no figures are supplied.

The present species is distinguished from *Aturia ziczac*, J. Sowerby, by its much more compressed whorls and less rapidly expanding shell, and by its more numerous septa. These distinctions have been observed in shells of equal size belonging to the two species in order that a fair comparison might be made.

Horizon. London Clay (Lower Eocene). Miocene.

Localities. Dax, Saubrigues (Landes), Bordeaux (Gironde), France¹; Turin, Italy; Malta.

Represented in the Collection by numerous examples. A specimen from Dax (No. 34385) and another from Saubrigues (No. 34386) were presented by John Sharp, Esq. Two specimens from Bordeaux (Nos. 36838 *a*, 36838 *b*) were presented by S. P. Pratt, Esq.

Var. **Australis**, M'Coy.

[See *suprà*, p. 336, fig. 71 *b*.]

- 1862. *Nautilus ziczac*, J. E. Woods, Geological Observations in South Australia, p. 83, woodcut.
- 1867. *Aturia Australis*, M'Coy, On the Recent Zoology and Palæontology of Victoria, Ann. Mag. Nat. Hist. ser. 3, vol. xx. p. 192.
- 1874. *Aturia Australis*, M'Coy, in Geol. Surv. of Victoria; Report of Progress by R. Brough Smyth, p. 36.
- 1876. *Aturia ziczac* (Sow. sp.), var. *Australis* (M'Coy), M'Coy, Geol. Surv. of Victoria; Prodr. of the Palæontology of Victoria, decade iii. p. 21, pl. xxiv.
- 1878. *Aturia ziczac*, Etheridge, Jun., Cat. of Australian Fossils, p. 171.

Sp. Char. "Sides flattened; periphery narrow, rounded; surface with fine arched striæ, the convexity forwards on the sides, backwards on the periphery. Diameter from 1 to $4\frac{1}{2}$ inches, proportional greatest width $\frac{4.5}{100}$ of an inch, length of aperture $\frac{6.5}{100}$, at middle $\frac{4.8}{100}$." (M'Coy.)

Remarks. M'Coy remarks with reference to the present variety:—"It is with the compressed Miocene variety found at Dax, named *N. Aturi* by Basterot, rather than with the more ventricose original

According to Mr. G. F. Harris the beds at these localities are of Oligocene, not Miocene, age. See Geol. Mag. dec. iii. vol. vii. 1890, p. 24.

types of the *N. ziczac* of Sowerby, proper to the Eocene London Clay, that our Australian fossil more completely agrees; and I can only doubtfully suggest the separation of it as a local variety, from the somewhat greater compression indicated by the slightly greater length of the aperture in proportion to its width; and also a slightly greater curvature of the septa on the sides, as shown by a line from the apex of the lancet-shaped lobe to the inner end of the same septum, encroaching rather more on the third chamber behind.

"Fragments have been found indicating a diameter of about 6 inches, but the majority of specimens found are under 2 inches."

This variety very closely resembles the Dax specimens of *Aturia Aturi*; a specimen from "Muddy Creek," Victoria (Australia), being quite indistinguishable at first sight from the Dax fossils. On comparing, however, a specimen of the latter with the Muddy Creek shell, both being of equal size, it is found that the Australian shell has a larger siphuncular orifice than the Dax specimen, thus adding another point of difference to those indicated by M'Coy as existing between the two forms. It may be added that the Australian shells from the Oligocene Tertiary beds near Mount Martha, from near the mouth of the Gellibrand River, and from the "Junction Miocene" beds of Bird Rock, south of Geelong, are preserved in a manner precisely similar to that of the Dax shells, that is, perfectly, as if they were recent shells.

One of the specimens figured by M'Coy¹ is an internal cast of the chambers of the present variety, found in the "hard ferruginous Lower Pliocene beds of Flemington." Casts of four chambers in a hard ferruginous rock are contained in the British Museum, and, though said to be from Muddy Creek, they answer the description of M'Coy's specimen from Flemington. A similar cast was figured by the Rev. J. E. Woods from Mount Gambier, under the name *Nautilus ziczac*².

*Horizon*³. Miocene? Lower Pliocene?

Locality. Muddy Creek, Victoria, Australia.

Represented in the Collection by two specimens: No. C. 1548 was presented by J. Dennant, Esq.; No. C. 1950 by Robert T. Litton, Esq.

¹ Prodr. of the Palæontology of Victoria, decade iii. pl. xxiv. f. 1.

² Geol. Observ. in South Australia [Victoria], 1862, p. 83.

³ There appears to be some doubt about the horizon of the beds whence the fossils above described were obtained. Mr. Robert Etheridge, Jun., in his 'Cat. Australian Foss.' (1878) p. 171, puts them in the "Lower or Middle Tertiary."

LIST of all the Species of the Genus *Nautilus* contained in the British Museum; arranged alphabetically under their respective Formations.

TRIASSIC.

- Nautilus linearis*, Münster, Beiträge zur Geognosie und Petrefactenkunde des südöstl. Tirol, p. 125, Taf. xiv. ff. 5, *a*, *b* (1841).
 — *privatus*, Mojsisovics, Die Cephalopoden der Mediterranen Triasprovinz (Abhandl. der k.-k. geol. Reichsanst. Band x.), p. 284, Taf. xc. ff. 3 *a*, 3 *b* (1882).
 — *Simonyi*, v. Hauer, Neue Ceph. v. Hallstatt und Aussee, in Haidinger's Naturwiss. Abhandl. Band iii. p. 5, Taf. i. ff. 12-14 (1849).
 — *Suessi*, Mojsisovics, Das Gebirge um Hallstatt (Abhandl. der k.-k. geol. Reichsanst. Band vi.), p. 26, Taf. vi. ff. 11, *a-c*, Taf. xiii. ff. 2 *a*, 2 *b* (1873).
 — (*Clydonautilus*) *Quenstedti*, v. Hauer, Neue Ceph. v. Hallstatt und Aussee, in Haidinger's Naturwiss. Abhandl. Band iii. p. 6, Taf. ii. ff. 1-3 (1849).
 — (—) *spirolobus*, Dittmar, Zur Fauna der Hallstädter Kalke (in Geognost.-paläontol. Beiträge, Band i. Heft ii. *b*), p. (34) 352, Taf. xiii. ff. 1, 2 (1866).
 — (*Hercoglossa*) *Sauperi*, v. Hauer, Cephalopoden des Muschel-marmors von Bleiberg in Kärnten, Haidinger's Naturwiss. Abhandl. Band i. p. 26, Taf. i. ff. 1-4 (1846.)

JURASSIC.

- Nautilus araris*, Dumortier, Études Paléontologiques du Bassin du Rhône, pt. iii. (1869), p. 56, pls. vi., vii.
 — *astacoides*, Young and Bird, Geol. Surv. Yorkshire Coast, 1828, 2nd ed. p. 270, pl. xiii. fig. 2.
 — *Baberi*, Morris and Lycett, Gt. Oolite Mollusca (Mon. Pal. Soc. 1850), pt. i. p. 10, pl. i. figs. 1, 1 *a*.
 — *Burtonensis*, Foord & G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 288 (1890), fig. 17.
 — *Calloviensis*, Oppel, Die Jura Formation Englands, Frankreichs und des südwestlichen Deutschlands, p. 547 (1857).
 — *clausus*, d'Orbigny, Pal. Franç., Terr. Jurass. vol. i. p. 158 (1842), pl. xxxiii.
 — *excavatus*, J. de C. Sowerby, Min. Conch. vol. vi. p. 55 (1826), pl. dxxix. fig. 1.
 — *Fischeranus*, Foord & G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 272 (1890), fig. 6.
 — *glaber*, Foord & G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 278 (1890), fig. 10.
 — *hexagonus*, J. de C. Sowerby, Min. Conch. vol. vi. p. 55 (1826), pl. dxxix. fig. 2.
 — *inornatus*, d'Orbigny, Pal. Franç., Terr. Jurass. vol. i. p. 152 (1842), pl. xxviii.

- Nautilus intermedius*, J. Sowerby, Min. Conch. vol. ii. p. 53 (1817), pl. cxxv.
- *Jourdani*, Dumortier, Études Paléontologiques du Bassin du Rhône, pt. iv. (Lias Sup.), p. 44 (1874), pl. vii. figs. 1–5.
- *lineatus*, J. Sowerby, Min. Conch. vol. i. p. 89 (1813), pl. xli.
- *lineolatus*, Foord & G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 393 (1890).
- *multiseptatus*, Foord & G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 283 (1890), fig. 13.
- *obesus*, J. Sowerby, Min. Conch. vol. ii. p. 51 (1816), pl. cxxiv.
- *ornatus*, Foord & G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 273 (1890), fig. 7.
- *perinflatus*, Foord & G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 286 (1890), fig. 15.
- *polygonalis*, J. de C. Sowerby, Min. Conch. vol. vi. p. 56 (1826), pl. dxxx.
- *pseudolineatus*, Foord & G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 277 (1890), fig. 9.
- *robustus*, Foord & G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 271 (1890), fig. 5.
- *semistriatus*, d'Orbigny, Pal. Franç., Terr. Jurass. vol. i. p. 149 (1842), pl. xxvi.
- *simillimus*, Foord & G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 267 (1890), fig. 1.
- *Smithi*, Foord & G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 287 (1890), fig. 16.
- *striatus*, J. Sowerby, Min. Conch. vol. ii. p. 183 (1817), pl. clxxxii.
- *subtruncatus*, Morris and Lycett, Gt. Oolite Mollusca (Mon. Pal. Soc. 1850), pt. i. p. 10, pl. i. figs. 2, 2a.
- *terebratus*, Dumortier, Études Paléontologiques du Bassin du Rhône, pt. iv. (Lias Sup.), p. 42 (1874), pl. vi. figs. 1–4.
- *Toarcensis*, d'Orbigny, Prod. de Paléont. Stratigr. vol. i. p. 245 (1849) [= *N. latidorsatus*, d'Orbigny, Pal. Franc., Terr. Jurass. vol. i. p. 147 (1842), pl. xxiv.].
- *truncatus*, J. Sowerby, Min. Conch. vol. ii. p. 49 (1816), pl. cxxiii.
- (*Hercoglossa*) *aganiticus*, Schlotheim, Die Petrefactenkunde, p. 83 (1820).
- (—) *Franconicus*, Oppel, Die Tithonische Etage, Zeitschr. der Deutsch. geol. Gesell., Band xvii. p. 546 (1865).
- (—) *Portlandicus*, Foord & G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 397 (1890), fig. 3.

CRETACEOUS.

- Nautilus Ahltenensis*?, Schlüter, Ceph. der oberen Deutschen Kreide, Palæontographica, Band xxiv. Abth. ii. p. 176 (1876), Taf. xlix. figs. 1, 2.
- *Albensis*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. ii. p. 122 (1850).

- Nautilus arcuatus*, Deshayes, Mém. Soc. Géol. de France, vol. v. pt. i. p. 14 (1842), pl. xviii. figs. 1 a, 1 b.
- *Atlas*, Whiteaves, Geol. Surv. Canada, Mesozoic Fossils, vol. i. pt. i. p. 17 (1876).
- *Bayfieldi*, Foord & G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 405 (1890), fig. 7.
- *Bellerophon*, Lundgren, Palæont. Iakttagelser öfver Faxekalken på Limhamn, p. 14 (1867), pl. —. figs. 1 a, 1 b.
- *Bouchar dianus*, d'Orbigny, Pal. Franç., Terr. Crét. vol. i. p. 75 (1840), pl. xiii.
- *Cantabrigiensis*, Foord, see *suprà*, p. 287.
- *Cenomanensis*?, Schlüter, 'Ceph. der oberen Deutschen Kreide,' Palæontographica, Band xxiv. Abth. ii. p. 168 (1876), Taf. xlv. figs. 1, 2.
- *Clementinus*, d'Orbigny, Pal. Franç., Terr. Crét. vol. i. p. 77 (1840), pl. xiii. *bis*.
- *Darupensis*?, Schlüter, 'Ceph. der oberen Deutschen Kreide,' Palæont. Band xxiv. Abth. ii. p. 176 (1876), Taf. xlix. figs. 4, 5.
- *Dekayi*, Morton, Synop. of the Organic Remains of the Cretaceous Group of the United States, p. 33 (1834), pl. viii. fig. 4.
- *Deslongchampsianus*, d'Orbigny, Pal. Franç., Terr. Crét. vol. i. p. 90 (1840), pl. xx.
- *elegans*, J. Sowerby, Min. Conch. vol. ii. p. 33 (1816), pl. cxvi.
- *elegantoides*, d'Orbigny, Pal. Franç., Terr. Crét. vol. i. (1840), p. 89.
- *expansus*, J. de C. Sowerby, Min. Conch. vol. v. p. 83 (1824), pl. cccclviii. fig. 1.
- *Farringdonensis*, Sharpe, Quart. Journ. Geol. Soc. vol. x. p. 181 (1854), pl. vi. figs. 1 a, 1 b.
- *Fittoni*, Sharpe, Foss. Mollusca Chalk (Mon. Pal. Soc.), p. 17 (1853), pl. vi. fig. 4.
- *Fleuriusianus*, d'Orbigny, Pal. Franç., Terr. Crét. vol. i. p. 82 (1840), pl. xv.
- *Heberti*, Binkhorst, Mon. des Gast. et des Ceph. de la Craie Supér. du Limbourg, p. 13 (1861), pl. v. b. figs. 1 a, 1 b.
- *Hunstantonensis*, Foord & G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 401 (1890), figs. 4, 5.
- *Huxleyanus*, Blanford, Mem. Geol. Surv. India, Pal. Indica, p. 19 (1861), pl. vii. figs. 3, 4, pl. viii. figs. 1-3, pl. ix. figs. 1-4.
- *inæqualis*, J. Sowerby, Min. Conch. vol. i. p. 88 (1813), pl. xl. (lower figs.).
- *Kayeanus*?, Blanford, Mem. Geol. Surv. India, Pal. Indica, p. 31 (1861), pl. xvi. figs. 5, 6.
- *Largilliertianus*, d'Orbigny, Pal. Franç., Terr. Crét. vol. i. p. 86 (1840), pl. xviii.
- *Libanoticus*, Foord & G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 404 (1890), fig. 6.
- *Neocomiensis*, d'Orbigny, Pal. Franç., Terr. Crét. vol. i. p. 74 (1840), pl. xi.

- Nautilus d'Orbigny*anus, Forbes, in Darwin's Geological Observations, pt. iii. Appendix, p. 265 (1846), pl. v. figs. 1 *a*, 1 *b*.
- *plicatus*, Fitton, Trans. Geol. Soc. vol. iv. pt. ii. p. 129, woodcut, (1835).
- *pseudoelegans*, d'Orbigny, Pal. Franç., Terr. Crét. vol. i. p. 70 (1840), pls. viii. & ix.
- *quadrilineatus*, Favre, Descrip. des Moll. Foss. de la Craie des environs de Lemberg en Galicie, p. 10 (1869), pl. iii. figs. 4 *a*, *b*.
- *radiatus*, J. Sowerby, Min. Conch. vol. iv. p. 78 (1822), pl. ccclvi.
- *Reussi*, Fritsch, Cephalopoden der böhm. Kreideformation, p. 25 (1872), Taf. xii. figs. 4, 5.
- *Saussureanus*?, Pictet, in Pictet and Roux, Moll. Foss. des Grès Verts des Environs de Genève, p. 17 (1847), pl. i. figs. 3, *a-c*.
- *semiundatus*, Foord, see *suprà*, p. 279.
- *Sowerbyanus*, d'Orbigny, Pal. Franç., Terr. Crét. vol. i. p. 83 (1840), pl. xvi.
- *sphæricus*, Forbes, Trans. Geol. Soc. ser. ii. vol. vii. p. 98, woodcut (1846).
- *sublævigatus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. ii. p. 189 (1850).
- *triangularis*, Montfort, in his edition of Sonnini's "Suite à Buffon" (Hist. Nat. des Mollusques, An. x.), vol. iv. p. 292 (1802), pl. xlix. fig. 2.
- *undulatus*, J. Sowerby, Min. Conch. vol. ii. p. 87 (1813), pl. xl.
- *vastus*, Kner, Haidinger's Naturwiss. Abhandl. Bd. iii. Abth. ii. p. 6 (1850), Taf. i. figs. 1, *a-c*.
- *ventroplicatus*, Foord, see *suprà*, p. 280.
- , sp., see *suprà*, p. 300.
- , sp., see *suprà*, p. 309.
- (*Hercoglossa*) *Danicus*, Schlotheim, Die Petrefactenkunde, p. 83 (1820).
- (—) *Lallierianus*, d'Orbigny, Pal. Franç., Terr. Crét. vol. i. p. 620 (1840).
- (—) *Saxbyi*, Morris, Quart. Journ. Geol. Soc. vol. iv. p. 193, woodcut (1848).
- (—) *Trichinopolitensis*, Blanford, Mem. Geol. Surv. India, Pal. Indica, p. 37 (1861), pl. xxiii., pl. xxiv. figs. 1, 2.

TERTIARY.

- Nautilus Allioni*, Michelotti, Descrip. des Foss. des Terr. Miocènes de l'Italie Septentrionale, pp. 347, 402 (1847), pl. xv. fig. 1.
- *centralis*, J. Sowerby, Min. Conch. vol. i. p. 11 (1812), pl. i. (left-hand figure).
- *decipiens*, Michelotti, Études sur le Miocène Infér. de l'Italie Septentrionale, p. 137 (1861), pl. xiii. fig. 11.
- *Deluci*, d'Archiac, Descrip. des Anim. Foss. du groupe Nummulitique de l'Inde, livr. ii. p. 337 (1854), pl. xxxv. figs. 2, 2 *a*.

- Nautilus ellipticus*, Schafhäütl, Süd-Bayerns Leth. Geogn. p. 214 (1863), pls. lvii. & lviii.
- *Forbesi*, d'Archiac, Descrip. des Anim. Foss. du groupe Nummulitique de l'Inde, livr. ii. p. 338 (1854), pl. xxxiv. figs. 12, 12 a.
- *Geelongensis*, Foord, see *suprà*, p. 332.
- *imperialis*, J. Sowerby, Min. Conch. vol. i. p. 9 (1812), pl. i. (upper and right-hand figures).
- *Labechei*, d'Archiac, Descrip. des Anim. Foss. du groupe Nummulitique de l'Inde, livr. ii. p. 338 (1854), pl. xxxiv. figs. 13, 13 a, 13 b.
- *macrocephalus*, Schafhäütl, Süd-Bayerns Leth. Geogn. p. 215 (1863), pl. liv. figs. 2, a-c.
- *Mokattamensis*, Foord, see *suprà*, p. 329.
- *regalis*, J. Sowerby, Min. Conch. vol. iv. p. 77 (1822), pl. ccclv.
- *Sowerbyi*, Wetherell, Phil. Mag. and Journ. vol. ix. p. 466 (1836).
- *urbanus*, J. de C. Sowerby, Min. Conch. vol. vii. p. 36 (1843), pl. dxxviii.
- , sp., see *suprà*, p. 330.
- (*Hercoglossa*) *Ægyptiacus*, Foord, see *suprà*, p. 334.
- (—) *Cassinianus*, Foord & G. C. Crick, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 408 (1890), fig. 9.

MANDIBLES OF FOSSIL NAUTILOIDS.

The calcified beaks of fossil Cephalopods have long been known under the general term Rhyncholites, first applied to them, in a generic sense, by Faure-Biguet¹. These remains had previously been described and figured by Knorr², J. F. Gmelin³, and Blumenbäch⁴, and afterwards by Schlotheim⁵, Blainville⁶, Roemer⁷, Bronn⁸, Buckland⁹, Münster¹⁰, and many others.

Various names have been bestowed upon these fossils. Thus,

¹ Considérations sur les Bélemnites; suivies d'un essai de Bélemnitologie synoptique, avec 1 pl.; Lyon, 1810. I have not seen this work, but quote it from Blainville.

² Verstein. ii. tab. H. i. a. figs. 9, 10.

³ Natursyst. d. Mineral-R. iii. tab. vi. figs. 79, 80. To this work I have not had access; the reference is taken from Schlotheim and Bronn.

⁴ Specimen Archæologiæ Telluris, 1803, p. 21, tab. ii. figs. 5, a, d.

⁵ Die Petrefactenkunde, 1820, p. 169; Atlas—Verstein. aus v. Schlotheim's Sammlung—tab. xxix. fig. 10.

Mémoire sur les Bélemnites, 1827, p. 114, figs. 11, 11 a, 11 b. 12, 12 a.

Die Verstein. des norddeutschen Oolithen-Gebirges, 1836, p. 207.

⁸ Lethæa Geognostica, 1837, Band i. p. 180, Taf. xi. figs. 17, a-c.

⁹ Bridgewater Treatises—Geology and Mineralogy, 1837, vol. i. p. 319, pl. xxxi. figs. 5-11.

¹⁰ Beiträge zur Petrefactenkunde, Heft i. 1843, p. 68, Taf. v.

Blumenbach described them as "*Sepiarum rostra*," Schlotheim as *Lepadites*¹, and Bronn used Blainville's name *Rhyncholithus*, while Blainville founded the genus *Concorhynchus* for the winged, lower mandibles, which were subsequently proved to belong to *Tennocheilus* ["*Nautilus*"] *bilorsatus*. Later still d'Orbigny established the genera *Palæoteuthis* and *Rhyncoteuthis*², with brief descriptions, but no figures. Bellardi³ described a fossil beak from the Miocene Tertiary of Piedmont under the name of *Scaptorrhynchus* and attributed it to a Decapod; but Prof. Dr. von Zittel suggests that it may have belonged to an *Aturia*⁴. He also points out⁵ that the opercula of *Neritopsis* have been mistaken by some authors for the beaks of Cephalopods and have been described as such.

Thus, Rolle⁶ described the operculum of *Neritopsis moniliformis* of the Miocene of Lapugy (Siebenbürgen), under the name *Cyclidia*, and the name *Rhynchidia* was bestowed by Laube upon the opercula of *Neritopsis*. *Peltarion*, Deslongchamps (*Scaphanidia*, Rolle⁷), supposed by that author to have been one of the beaks of a Cephalopod, was also shown by M. J. Beaudouin⁸ to be the operculum of a *Neritopsis*; and the *Chiton Rhæticus* of Moore⁹ has similar affinities. The *Rhyncholithus Buchi*, Müller (Monographie der Petref. der Aachener Kreideformation, Abth. ii. 1851, p. 60, tab. vi. figs. 13, A, B, C), may be added also to this list.

Buckland¹⁰ and Mantell¹¹ appear to be the only authors who have figured Rhyncholites from the British rocks. Morris¹² merely states that "these bodies [Rhyncholites] have been found in the Lias, Lyme Regis, and Lower Chalk, Dover, Kent," but he gives no references to any writings concerning them.

¹ Supposing them to be the opercular valves of a *Balanus*. Petrefactenkunde, 1820, p. 169.

² Prodrome de Paléont. Stratigraphique, 1849, vol. i. p. 327.

³ I Molluschi dei Terreni Terziari del Piemonte e della Liguria, 1872, pt. i. p. 12, tav. i. figs. 2, a-c.

⁴ Handbuch der Palæontologie, Band i. Abth. ii. Lief. iii. 1884, p. 387.

⁵ Loc. cit. Lief. ii. 1882, pp. 202, 203.

⁶ "Ueber eine neue Cephalopoden-Gattung aus den Tertiärschichten von Siebenbürgen," Sitzungsber. d. k.-k. Akad. 1862, Band xlv. p. 119.

⁷ Loc. cit. p. 127.

⁸ Bull. Soc. Géol. de France, sér. 2, vol. xxvi. p. 182.

⁹ Quart. Journ. Geol. Soc. 1861, vol. xvii. p. 511, pl. xvi. ff. 28, 29.

¹⁰ Bridgewater Treatises—Geology and Mineralogy, 1837, vol. i. p. 319; vol. ii. p. 53, pl. xxxi. figs. 5, 6.

¹¹ "Medals of Creation," 1844, vol. ii. p. 478, 'Beaks of *Nautilus*,' Chalk Marl, woodcut 105, figs. 1, 1 a, 1 b.

¹² Cat. British Fossils, 2nd ed. 1854, p. 313.

D'Orbigny¹ was the first to refer some of these fossil Cephalopodous beaks to the genus *Nautilus*, from their resemblance to those of the recent animal. He remarks that Faure-Biguet, who gave them the generic name of *Rhyncholites*, expressed no opinion as to their being the mandibles of Cephalopods, nor as to what animal they may have belonged to. M. Gaillardot, in 1824 (Ann. des Sci. Nat. vol. ii. p. 485), adopted the opinion of Guettard, who considered them to be the mandibles of an animal allied to *Sepia*. But this opinion was disputed by d'Orbigny², for the obvious reason that the beaks of *Sepia* and of other Cephalopods without chambered shells are corneous, whereas the fossil beaks are "always thick, full of calcareous matter, and of a different form."

Finally d'Orbigny separated the fossil beaks of Cephalopods into two groups, placing those of a triangular form, and concave beneath, in Blainville's genus *Conchorhynchus*; while for the wide and compressed forms he created the genus *Rhynchoteuthis*, rejecting the name *Rhyncholites* as being "too vague and often applied to the Echinids," indicating only a "fossil beak, which might as well be a beak of a *Balanus*, or that of a Bird." He combats the idea expressed by M. Deshayes (Encycl. Méth., art. Lechi, vol. iii. p. 944) that a generic name cannot be properly applied to a mandible, which is only a part of the animal, by observing that upon such a principle it would be necessary to suppress half the fossil genera described, when only part of the organism is known, as in the case of *Belemnites*, and even all the Mammalia and Mollusca, the animals of which can never be known. On the contrary, d'Orbigny holds that all fossil remains that cannot be referred to any known genera should be placed as genera in whatever animal series they approach nearest to.

This is sound reasoning if applied to Palæontology in a general sense; but in this particular instance its application is rendered difficult by the want of stable characters upon which to found genera and species of fossil beaks. Nor is the material sufficiently abundant to enable one to trace the variations that may arise in different stages of growth, and thus to afford data for the limitation of such species as may be constituted. Under these circumstances I have merely figured some of the principal types of the fossil beaks

¹ Mollusques Vivants et Fossiles, 1845, vol. i. p. 587. The figures which should have accompanied this volume were never published.

² *Loc. cit.* p. 588. Extract from Ann. des Sci. Nat. 1825, vol. v., Juin.

met with in the Jurassic and Cretaceous rocks of England which, so far as I am aware, have not yet been illustrated¹.

The Rhyncholites, like the Aptychi of the Ammonites, are found, as a rule, isolated, so that their connection with any given species is largely a matter of conjecture.

There seems ample justification for the conclusion that *Rhyncholites hirundo*, Faure-Biguet, and *Conchorhynchus avirostris* Schlotheim, sp., are, respectively, the upper and lower mandibles of *Temnocheilus bidorsatus* of the Muschelkalk of Bavaria, &c. Furthermore, the beaks of a *Nautilus*—*N. Libanoticus*, Foord and G. C. Crick²—from the Upper Chalk of Lebanon, Syria, are preserved *in situ* (see fig. 82). There are thus two forms of fossil Nautiloid beaks which may be compared with those whose affinities have not yet been established³.

Before presenting figures of some of the mandibles of fossil Cephalopods in the British Museum collection, I give here (fig. 76) figures of the detached mandibles of *Nautilus pompilius* for comparison with the former. In addition to these I have copied (fig. 77) part of Sir R. Owen's figure on plate iv. of his 'Memoir on the Pearly Nautilus,' showing the mandibles in their natural position, by which their relation to the buccal mass and surrounding parts may be better comprehended.

Sir R. Owen⁴ thus describes these mandibles:—"The calcareous extremities of both mandibles are of a hardness apparently adequate to break through the densest crustaceous coverings, or even shells of moderate thickness. That of the upper mandible is sharp-pointed, and solid to the extent of five lines from the extremity; but in the lower one the calcareous matter is deposited on both sides of a thin layer of the black horny substance, and thus a combination of tough with dense matter is obtained, which much diminishes the liability to fracture. This mandible is also more hooked than the upper one, but is more obtuse at the end: it

¹ With the exception of those figured in a very sketchy manner by Buckland, from imperfect specimens. See Bridgewater Treatises—Geol. and Min. 1837, vol. i. p. 319; vol. ii. p. 53, pl. xxxi. figs. 5, 6. Mantell's figures are merely outlines; see 'Medals of Creation,' 1844, vol. ii. p. 478, woodcut 105, figs. 1, 1 a, 1 b.

² See *suprà*, p. 304.

³ Buckland (Bridgewater Treatises—Geol. and Min. 1837, vol. ii. p. 54, footnote) remarks that he possessed "a specimen of a fossil *Nautilus* from the Lias at Lyme Regis, in which the external open chamber" contained a Rhyncholite.

⁴ 'Memoir on the Pearly Nautilus,' 1832, p. 21, pl. viii. figs. 2-5.

seems from its dentated margin evidently intended to break through hard substances, whilst the sharp edges of the beak of the Cuttle-fish better adapt it for cutting and lacerating the soft bodies of fish. Indeed, in the particulars just mentioned, the mandibles of *Nautilus* differ from those of every other known species of recent Cephalopoda. There are, however, certain fossils called *Rhyncholites*, formerly considered to be the beaks of fossil birds, but recognized by Blumenbach as appertaining rather to the *Cephalopoda*, although

Fig. 76.



Nautilus pompilius.—*a*, front view of lower mandible showing the dentated margin of the calcareous upper part; *b*, lateral view of the same, showing the widely expanded horny laminae of this mandible; *c*, lateral view of the upper mandible with its hood-like expansion; *d*, front view of the same, showing the limits of the calcareous extremity of the mandible on the underside. The calcareous extremities of the mandibles are indicated in figures *b*, *c*, *d* by lighter shading, and a light irregular line shows the extent of the calcareous matter. This could not well be indicated in *a* without interfering with the definition of the dentated margin. Drawn of the natural size from specimens in the Geological Department, British Museum.

evidently differing from all the recent genera then known. M. d'Orbigny having invariably met with a large kind of these *Rhyncholites* in the same stratum with the fossil shell of a large *Nautilus* (*Nautilus gigas*), suspected from that circumstance that they might be the mandibles of that species (see his Memoir in the Ann. des Sci. Nat. v. p. 211, pl. 6). The calcareous extremities of the mandibles of *Nautilus pompilius*, and the peculiarities of their form, especially the flattened superior surface of the upper mandible, fully confirm that conjecture, and at the same time show that a small portion only of the beak is represented by the fossil."

Remarks. The resemblance between the calcareous extremity of the upper mandible of *Nautilus pompilius* represented in figure 76, *d*, and the corresponding fossil mandibles (figures 78, *c* and *f*; 79, *d*;

80, *a* and *e*; 82; 83, *b*) will not be disputed. There seems to be, therefore, sufficient evidence upon which to rest the assumption that the fossil mandibles referred to belonged to the genus *Nautilus*. They do, indeed, vary in detail; but such variations may be significant of specific, rather than of generic differences in the animals to which the beaks belonged, or they may be due simply to difference in age. There is still much force, however, in Buckland's¹ contention that "although the resemblances between these

Fig. 77.



Nautilus pompilius.—*a*, part of the hood, or upper part of the oral sheath, longitudinally divided and turned back; *e*, *e*, the cut surfaces of the same; *f*, *f*, the internal surface of the oral sheath; *g*, *g*, the external labial processes; *h*, *h*, the external labial tentacles; *i*, *i*, the internal labial processes; *k*, *k*, the internal labial tentacles; *l*, the olfactory laminae; *m*, *m*, the circular fringed lip, longitudinally divided; *n*, the upper mandible; *o*, the lower mandible; *p*, the muscular basis on which the mandibles are fixed; *q*, *q*, the superior pair of muscles which retract the jaws; *r*, *r*, the semicircular muscle which protrudes the jaws, divided longitudinally. Copied from pl. iv. of Owen's 'Memoir on the Pearly Nautilus' (1832).

fossil beaks, and that of the animal inhabiting the *N. pompilius*, are such as to leave no doubt that Rhyncholites are derived from some kind or other of Cephalopod, yet, as they are found insulated in strata of Muschelkalk and Lias, wherein there occur also the remains of Sepiæ that had no external shells, we have not yet sufficient evidence to enable us to distinguish between the Rhyncholites derived from naked Sepiæ, and those from Cephalopods that were connected with chambered shells." This last consideration has, no doubt, led some palæontologists to describe fossil beaks under generic and specific names, with the view of escaping the difficulty

¹ Bridgewater Treatises—Geology and Mineralogy, 1837, vol. ii. p. 54 (foot-note).

of allocating them with described genera of Cephalopods. The result is far from satisfactory. A few arbitrary and by no means clearly defined genera have been established, to which a number of more or less widely differing "species" have been referred. The most ambitious attempt in this connection was made by d'Orbigny¹, who began a monograph of the Rhyncholites; but after describing several species (see list, *infra*, p. 375) his work was stopped,—plates and figures being referred to which were never published², nor are the dimensions of the specimens given in the descriptions, whereby the species might have been identified.

Pictet and de Loriol³ adopted d'Orbigny's genus *Rhynchoteuthis*, and described and figured three species, admitting, however, that two of them might have been different mandibles from the same mouth. They remark that the bed in which they occur contains a great number of the beaks they describe, associated with the remains of Belemnites. In the 'Terrain Crétacé de Sainte-Croix'⁴ MM. Pictet and Campiche, after describing a new species of *Rhynchoteuthis* (*R. quinquecarinatus*, see *infra*, p. 368), give a catalogue of the Cretaceous species of that genus, with brief descriptions of each species. These are embodied in my list (see *infra*, p. 374).

TRIASSIC.

The Collection contains many excellent specimens of the upper and lower mandibles of *Temnocheilus bidorsatus* from Germany and France. These have not been figured here because they have been thoroughly illustrated in some of the older palæontological works, such as Münster's 'Beiträge zur Petrefactenkunde' (Heft i. 1843, Taf. v.), and Bronn's 'Lethæa Geognostica' (1837, Band i. Taf. xi. fig. 17, a-c).

It is singular that (with one exception recorded by Roemer) no beaks should have been found in the Carboniferous rocks, in which the shells of Nautiloids are so abundant.

Horizon. Muschelkalk.

Localities. Baireuth, Laineck (near Baireuth), Bavaria; Lunéville (Meurthe-et-Moselle), France.

¹ Mollusques vivants et fossiles, vol. i. 1845, p. 587.

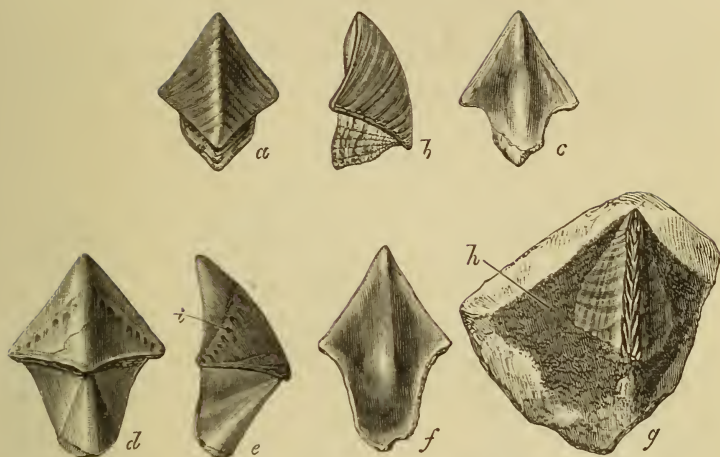
² Pictet and de Loriol—Description des Fossiles contenus dans le Terrain Néocomien des Voirons (Pal. Suisse, sér. ii. 1), 1858, p. 35.

³ Descrip. des Foss. Terr. Néocom. des Voirons (Pal. Suisse, sér. ii. 1), 1858, p. 34.

⁴ Pal. Suisse, sér. iii. 1862, p. 162.

JURASSIC.

Fig. 78.



a, view of the outer side of an upper mandible (No. 34509); *b*, lateral view of the same, showing a pad or swelling below the point of the beak; *c*, inner side of the same, showing a median, longitudinal swelling, increasing towards the extremity of the beak. From the Inferior Oolite of Swanswick, Bath. *d*, view of the outer side of an upper mandible (No. 34039 *a*); *e*, lateral view of the same, showing at *i* a series of shallow pits, caused perhaps by a fringed lip (see fig. 77, *m, m*); *f*, inner side of the same, showing a slight central swelling, which is continued, less prominently, towards the apex of the beak; *g*, view of the outer side of a lower mandible (No. C. 1526) with (*h*) remains of the horny expansions converted into carbonaceous matter. The line of fine ridges which gives such an ornamental aspect to the lower mandibles was doubtless connected with the muscular attachment. From the Lias of Lyne Regis. All the figures are drawn of the natural size from specimens in the British Museum.

Remarks. D'Orbigny¹ has figured an upper mandible from the Inferior Oolite of Moutiers (Calvados), which he ascribes provisionally to *Nautilus lineatus* (= *Nautilus obesus*, J. Sow.), because it is the largest *Nautilus* of those beds. There is a specimen from the same locality (Moutiers) in the British Museum (No. 73982). A large, imperfectly preserved specimen (No. 24235), from the Inferior Oolite of Yeovil, Somersetshire, resembles this one, but it is of a narrower form.

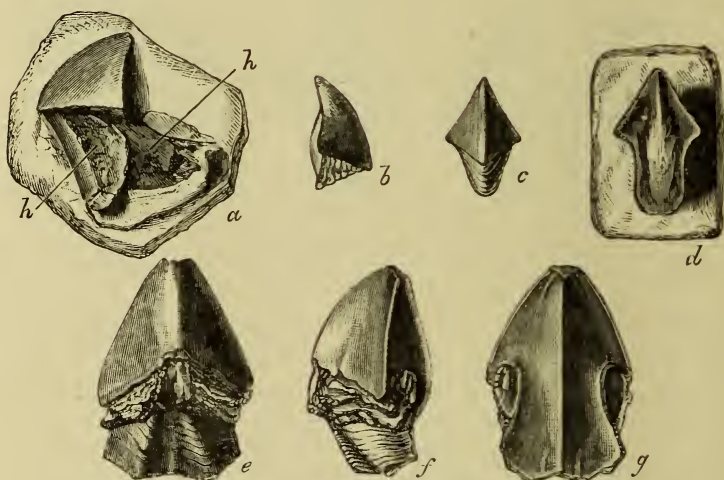
¹ Pal. Franç.—Terr. Jurass. 1842, vol. i. pl. xxxix. figs. 3-5.

The specimen here figured (fig. 78, *a-c*) is remarkable for the brevity of the posterior portion; in other respects it is like the French specimen.

Referring to figure 78 (*d-g*) it may be mentioned that there are several examples in the Collection of a narrower and sharper form of (upper) mandible, also from the Lias of Lyme Regis, which probably belonged to a different species of *Nautilus* (?) to the one here figured¹.

CRETACEOUS.

Fig. 79.



a, lateral view of an upper mandible, showing at *h, h* remains of the horny lamina converted into carbonaceous matter; *b*, lateral view of a smaller upper mandible of narrower and more pointed form than *a*; *c*, view of the outer side of the same; *d*, inner side of an upper mandible. All from the Gault of Folkestone. The specimens figured are numbered C. 842 *a*, *b*, *c*, in the Collection, and are drawn natural size. *e*, view of the outer side of an upper mandible; *f*, lateral view of the same; *g*, inner side of the same showing the strong median keel, seen also in *f*.

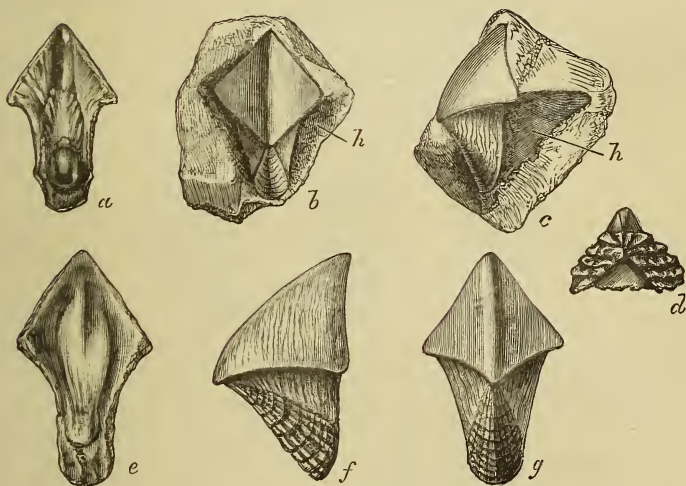
Remarks. The specimen lettered *e-g* appears to be the *Rhyncho-teuthis quinquecarinatus* of Pictet and Campiche². It differs from the Gault and Chalk mandibles in its extremely robust form, and in

¹ See the specimens numbered 35053, 37288, and 46490.

² Terrain Crétacé de Sainte-Croix, 1862, sér. iii. p. 161, pl. lix. fig. 9, *a-c*.

the sharp and strong median keel on its under surface, and the sharply keeled borders, separating the latter from the upper surface. Two less conspicuous keels are seen on each side of the median one, extending posteriorly from the beaks; these make five keels in all: hence the name. From the Neocomian of the South of France (No. 73814 *a*). The figures are drawn of the natural size, from a specimen in the British Museum.

Fig. 80.



a, view of the inner side of an upper mandible; *b*, view of the outer side of an upper mandible, showing on one side (*h*) remains of the horny lamina appearing as a red stain upon the chalk; *c*, lateral view of the same specimen; *d*, view of the dentated margin of the apical part of a lower mandible (cf. *Nautilus pompilius*, Fig. 76, *a*, *b*). *a* (No. 98207) is from the Chalk of Offham Pit, Lewes, Sussex; *b*, *c* (No. 39788) is from the Lower Chalk of Maidstone, Kent; *d* (No. 37869) is from the Lower Chalk of Dover, Kent; *e*, view of the inner side of an upper mandible; *f*, lateral view of the same specimen, showing the ridged posterior portion; *g*, outer side of the same. From the Upper Greensand of Devizes, Wilts (No. 88876 *a*). All the specimens are drawn of the natural size from specimens in the British Museum.

Remarks. The Chalk forms (fig. 80, *a-d*) closely resemble those of the Gault (cf. fig. 79, *a-d*), both in shape and internal markings. In both there is a very thick pad or swelling developed on the internal aspect of the upper mandible, extending for about two thirds of the distance from the base towards the apical extremity.

Besides the specimen figured (fig. 80, *d*) there are two other specimens of lower mandibles from the English Chalk (Nos. 32746 and C. 70), but they are neither of them in a fit condition for illustration. Two upper mandibles from the Chalk of Ciply, Belgium, are also badly preserved; one is a broad, and the other a narrow form.

The Upper Greensand form here figured (fig. 80, *e-g*) must have belonged to a large *Nautilus*. There are several of this type in the Collection, varying but little in size and precisely similar in form and markings. The largest (No. 23270 *a*) is 1 inch 4 lines long, and 10 lines in its greatest breadth.

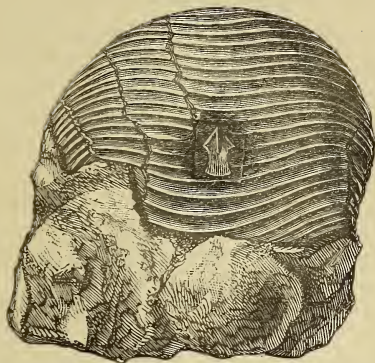
Fig. 81.



a, view of the inner side of an upper mandible, showing a conspicuous median longitudinal keel (the interruption near the apex is apparently due to fracture, because in another (smaller) specimen the keel is intact throughout its length); *b*, lateral view of the same specimen; *c*, outer side, showing the central depression of the posterior part of the mandible. From the Cambridge Greensand, Cambridge. Drawn of the natural size from a specimen in the British Museum (No. 39626).

Remarks. This type of mandible is so strikingly like the one I have figured from the Neocomian of France (fig. 79, *e-g*) that there can be no doubt that they both belonged to a similar form of Cephalopod. Whether this was a *Nautilus* or not it is impossible to affirm with certainty. There is here, at any rate, decided departure from the type of structure exhibited in other mandibles, the bulk of which latter may with much probability be ascribed to *Nautilus*—*i. e.*, of course, in the restricted application of that term as employed in the present Catalogue.

Fig. 82.

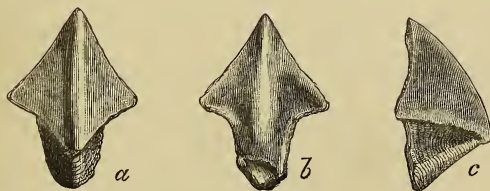


NAUTILUS LIBANOTICUS, Foord and G. C. Crick.
[See *suprà*, p. 305, fig. 67, *c, d.*]

Remarks. There are five specimens in the British Museum from the Upper Cretaceous of Lebanon, exhibiting the mandibles associated with the shell, and in each example there is a brownish stain surrounding the mandible, caused, no doubt, by the decay of the animal matter. The beaks are all exposed upon the surface of the cast of the ventral aspect of the body-chamber of the shell. The largest mandible (figured *suprà*, p. 305, fig. 67, *d*), when perfect, would have measured about 5 lines in length, with a greatest breadth of about 3 lines. It is attached to a specimen (No. C. 2918) which is about $3\frac{1}{2}$ inches long (allowing for compression) and 2 to $2\frac{1}{2}$ inches broad. Some idea may thus be formed of the relative size of these fossil mandibles to the shells they belonged to.

TERTIARY.

Fig. 83.



a, view of the outer side of an upper mandible; *b*, inner side of the same; *c*, lateral view of the same. Drawn of the natural size from a specimen in the British Museum from the Miocene of Malta.

Remarks. This type of mandible departs in no essential feature from that of the Cretaceous, except that the posterior portion is somewhat shorter than it is in the generality of Cretaceous forms. The present form bears some resemblance to one described and figured by Bellardi¹ from the Middle Miocene of Piedmont under the name of *Rhyncholithes Allionii*, but the proportions of the two are different.

JURASSIC AND CRETACEOUS MANDIBLES OF UNCERTAIN AFFINITIES.

The mandibles above figured (figs. 78-83) bear such a close resemblance to those of the recent *Nautilus* (*N. pompilius*) (figs. 76, 77) as to justify their reference to the latter with a considerable measure of certainty². But there are other mandibles in the Collection of a totally distinct type from any of those I have figured, and therefore it may be fairly concluded that they do not belong to the genus *Nautilus*; but whether they belong to *Ammonites* or *Belemnites*, or to non-testaceous Cephalopods, there is, at present, no evidence to show.

The following types of mandible are more or less satisfactorily determinable:—*Rhynchoteuthis Quenstedti*, Ooster³. This type of upper mandible is recognizable as one of the two or three distinct forms figured by Quenstedt in his 'Petrifactenkunde Deutschlands'⁴, all of which he erroneously referred to the *Rhyncholithes acutus* of Blainville⁵. Subsequently Ooster in 1857 (*loc. cit.*), selecting one of the forms figured by Quenstedt (Petr. Deutschl.

¹ I Molluschi dei Terreni Terziari del Piemonte e della Liguria, 1872, pt. i. p. 22, tav. iii. fig. 2, a-c.

² The form (fig. 79, e-g) referred to *Rhynchoteuthis quinquecarinatus* should perhaps be excepted, as also fig. 81. Both these possess in the sharp keel on the inside of the upper mandible a character which distinguishes them very markedly from the other forms figured.

³ Catalogue des Céphalopodes Fossiles des Alpes Suisses, pt. ii. 1857, p. 5, tab. iv. figs. 15, 16.

⁴ Petr. Deutschl. 1846-1849, Abth. i. Band i. Cephalopoden, p. 547, tab. xxxiv. figs. 16, a, b, but not figs. 17, 18, 19.

⁵ Mém. sur les Bélemnites, 1827, pl. v. figs. 22, 22 a, 22 b (*Rhyncholithes aigu*). Neither of the forms figured by Quenstedt agrees with Blainville's, which is, however, a not very clearly marked form. D'Orbigny (Moll. Viv. et Foss. vol. i. 1845, p. 595) makes it a synonym of his *Rhynchoteuthis Emerici*.

tab. xxxiv. fig. 16, *a, b*), described and figured it under the name *Rhynchoteuthis Quenstedti*, and this name was again employed (1858) by MM. Pictet and de Loriol¹ for a Neocomian type.

There is no locality recorded against the specimens, but as they form part of the Tesson Collection (No. 73988 *a*), they are probably from France. The horizon is either Jurassic or Cretaceous, probably the latter; and the same observation applies to 73988 *b* and 73988 *c*. The upper mandibles numbered 73988 *b* are perhaps referable to Pictet and de Loriol's *Rhynchoteuthis Quenstedti*, mentioned above as distinct from Ooster's type of the same name. These are also from the Tesson Collection, and are without locality and horizon.

A type of upper mandible which is remarkable for the very small size of the posterior part, agrees in the main with Quenstedt's *Rhyncholithes acutus*, as figured by him in the Atlas to his 'Cephalopoden' (1849), tab. xxxiv. figs. 17, *a-c* (not figs. 16, 18, 19). The same form is also figured by Quenstedt in his 'Handbuch der Petrefactenkunde' (1852), tab. xxxii. fig. 12, and in the new edition (1884, Abth. iii.) of the same work, tab. xlviii. fig. 10. The specimens are from the Tesson Collection, and are numbered 73988 *c*.

A remarkably beautiful little upper mandible (No. 73985), with a very prominent longitudinal ridge on the under side, resembles somewhat the *Rhynchoteuthis Fischeri* of Ooster². The specimens of upper mandibles (numbered 37135) from the Neocomian of the South of France evidently belong to the same type, so that the first-named specimen may be safely referred to the same locality and formation.

The upper mandibles numbered 73985 *a*, from the Oxfordian of St. Pierre (Isère), France, agree well with d'Orbigny's description of *Rhynchoteuthis Larus*, Faure-Biguet³, to which they may therefore be referred.

¹ Pictet and Campiche (Terr. Crét. de Sainte-Croix, Pal. Suisse, sér. iii. 1862, p. 163) give 1859 as the date of Ooster's species, giving Pictet and de Loriol's name the priority thereby. But this is an error, as the date of pt. ii. of the 'Catal. des Céph. Foss. des Alpes Suisses,' in which all Ooster's species of *Rhynchoteuthis* were described and figured, is 1857. I have verified the latter date by turning to Ooster's original memoir contained in vol. xvii. of the 'Nouveaux Mémoires de la Société Helvétique des Sciences Naturelles.'

² Catalogue des Céphalopodes Fossiles des Alpes Suisses, pt. ii. 1857, p. 3, tab. iv. figs. 2-5 (not 11-14).

³ Considérations sur les Bélemnites, 1819, p. 58, pl. vi. fig. 2. See also d'Orbigny, in Annales des Sciences naturelles, vol. v. p. (218), pl. vi. figs. 2, *a-d*.

Numerous specimens of upper mandibles (No. C. 1527) from the Oxfordian of Hiéges (Basses-Alpes) are of a slightly more elongate form than *R. Larus*, and are referable to d'Orbigny's *R. Coquandianus*¹.

A single upper mandible (No. 73987) from the Neocomian of Cheiron (Basses-Alpes) agrees tolerably well with d'Orbigny's description of his *Rhynchoteuthis alatus*², but in the absence of figures its identification is very difficult.

There are numerous detached mandibles, both upper and lower, in the Collection from the Lias of Charmouth and Lyme Regis, Dorsetshire (Nos. 35054 and 46754), which present different characters from any of those above referred to. Perhaps if careful search were made, some of these mandibles might be discovered in connexion with the cephalopod to which they belong, or at least in such a position as to warrant a safe assumption as to their affinities—that is, supposing they belonged to any shell-bearing Cephalopod, or to a Belemnite.

LIST of Rhyncholites described under specific names³.

CARBONIFEROUS.

Rhyncholithes? *Stella*, F. A. Roemer, Palæontographica, 1854, Band iii. p. 52, tab. viii. fig. 17, a-c.

TRIASSIC.

Rhyncholithes acuminatus, Merian, Neues Jahrbuch, 1837, p. 727.

Conchorhynchus avirostris, Bronn, Lethæa Geognostica, zweite Aufl., 1837, Band i. p. 182; Atlas, Taf. xi. fig. 16, a-c.

— *Cassianus*, (Herm. v. Meyer) Klipstein, Beiträge zur geologisch. Kenntn. der östlichen Alpen, 1843, p. 145, Taf. ix. fig. 7, a, b.

Rhyncholithus duplicatus, Münster, Beiträge zur Petrefactenkunde, 1843, Heft i. p. 70, Taf. v. figs. 4, 5 (= *Conchorhynchus duplicatus*, d'Orb.).

*Rhyncholites Gaillardoti*⁴, d'Orbigny, Ann. des Sci. Nat. 1825, vol. v. p. (219). Figured, ibid. vol. ii. p. 485, tab. xxii. figs. 3-14.

¹ Moll. Viv. et Foss. 1847, vol. i. p. 597.

² Paléont. Franç., Terr. Crét., Suppl. 1847, p. 27. Many of the plates referred to in this volume were never published, and amongst them those in which the present species should have been figured.

³ I have endeavoured to make this list as complete as possible.

⁴ This appears to be the *Conchorhynchus avirostris*, Bronn.

- Rhyncholithus hirundo*, (Faure-Biguet) Bronn, Lethæa Geognostica, zweite Aufl. 1837, Band i. p. 181, Taf. xi. fig. 17, *a-c*.
 — *Orbignyianus*, Münster, Beiträge zur Petrefactenkunde, 1843, Heft i. p. 70, Taf. v. figs. 11, 12.

JURASSIC.

- Rhynchoteuthis antiquatus*, Rousseau¹, Demidoff's Voyage dans la Russie Méridionale et la Crimée, vol. ii. 1842, p. 593, Atlas, pl. i. figs. 1, 1 *a*, 1 *b*, 1 *c* (the last three greatly enlarged); also, d'Orbigny, Moll. Viv. et Foss. 1847, p. 595².
 — *Brunneri*, Ooster, Catalogue des Céphalopodes Fossiles des Alpes Suisses, 1857, pt. ii. p. 6, tab. iv. figs. 17–19.
 — *Bucklandi*, Ooster, *ibid.* p. 7, tab. iv. fig. 20.
 — *cameræ*, Dumortier, Sur quelques Gisements de l'Oxfordien Inférieur de l'Ardèche, 1871, p. 25, pl. ii. figs. 16, 17.
 — *Cellensis*, Dumortier, *ibid.* p. 25, pl. ii. figs. 12–15.
 — *Coquandianus*, d'Orbigny, Moll. Viv. et Foss. 1847, p. 597.
 — *Emerici*, d'Orbigny, Tabl. des Céphalopodes, 1825, p. 72; also Moll. Viv. et Foss. 1847, p. 595.
Rhynchoteuthis Escheri, Ooster, Catalogue des Céphalopodes Fossiles des Alpes Suisses, 1857, pt. ii. p. 4, tab. iv. figs. 11–14.
 — *Fischeri*, Ooster, *ibid.* p. 3, tab. iv. figs. 2–5 and 32.
Rhyncholites gigantea, d'Orbigny, Ann. des Sci. Nat. vol. v. p. 221; Atlas, pl. vi. figs. 1, *a-c*.
Rhynchoteuthis Honoratianus, d'Orbigny, Moll. Viv. et Foss. 1847, p. 594.
 — *Larus*, Faure-Biguet, Considérations sur les Bélemnites, 1819, p. 58, pl. vi. fig. 2; also, d'Orbigny, Annales des Sciences naturelles, vol. v. p. (218), pl. vi. figs. 2, *a-d*.
 — *Meriani*, Ooster, Catalogue des Céphalopodes Fossiles des Alpes Suisses, 1857, pt. ii. p. 10, tab. iv. figs. 24–26.
 — *Meyrati*, Ooster, *ibid.* p. 9, tab. iv. figs. 21–23.
 — *Morloti*, Ooster, *ibid.* p. 8, tab. iv. figs. 6, 7, and 39–41.
 — *Quenstedti*, Ooster, *ibid.* p. 5, tab. iv. figs. 15, 16.
Rhyncholites Voltzii, F. A. Roemer, Die Versteinerungen des norddeutschen Oolithen-Gebirges, 1837, p. 207, tab. xii. figs. 15, *a-c*.

¹ The figures of this species given in Demidoff's 'Voyage' show that it is nearly allied to *R. Larus*, d'Orbigny. The species is quoted in the text of M. Demidoff's work under the name *antiquitatus*, but on the plate it is written *antiquatus*, under which name d'Orbigny refers to it.

² Plates and figures are referred to as illustrating this and other species described in d'Orbigny's 'Mollusques Vivants et Fossiles,' but they were never published, and therefore it would be useless to quote them.

CRETACEOUS.

- Rhynchoteuthis alatus*, d'Orbigny, Paléont. Franç., Terr. Crét., Suppl. 1847, p. 27, pl. xi. figs. 1-4¹.
- Rhyncholithes aquisgranensis*², Müller, Monographie der Petrefacten der Aachener Kreideformation, 1847, p. 45, Taf. i. figs. 4, a-d.
- Rhynchoteuthis Astierianus*³, d'Orbigny, Paléont. Franç., Terr. Crét., Suppl. 1847, p. 27, pl. xi. figs. 5-7.
- Rhyncholithus cretaceus*, Hagenow, Neues Jahrbuch für Min. &c., 1842, p. 567.
- Rhynchoteuthis Debeyi*, Müller, Monographie der Petrefacten der Aachener Kreideformation, Abth. ii. 1851, p. 61, Taf. vi. figs. 14, A, B, C.
- *Dutemplei*⁴, d'Orbigny, Paléont. Franç., Terr. Crét., Suppl. 1847, p. 28.
- *fragilis*, Pictet and de Loriol, Descrip. des Foss. Terr. Néocom. des Voirons (Pal. Suisse, ser. ii. pt. 1), 1858, p. 35, pl. viii. figs. 3 a, 3 b, 4 a-d.
- *hasta*, Faure-Biguet, Considérations sur les Bélemnites, 1819, p. 59.
- *minima*, Marck, Zeitschr. der Deutsch. geol. Ges. Band x. 1858, p. 266, Taf. vii. figs. 13, 14.
- *Monasteriensis*, Marck, *ibid.* p. 265, Taf. vii. fig. 12.
- *Picteti*, Ooster, Catalogue des Céphalopodes Fossiles des Alpes Suisses, pt. ii. 1857, p. 11, tab. iv. figs. 27-29.
- Rhyncholithes pusillus*, Kade, Verstein. des Schanzenberges bei Meseritz, p. 15, fig. 12. (*Fide* Marck, *loc. cit.* p. 266.)
- Rhynchoteuthis Quenstedti*, Pictet and de Loriol, Descrip. des Foss. Terr. Néocom. des Voirons (Pal. Suisse, sér. ii. pt. 1), 1858, p. 39, pl. viii. figs. 5, a-d. (*Not of* Ooster.)

¹ This plate, as well as others referred to in d'Orbigny's Supplement, was never published. D'Orbigny refers also to a figure of this species in his Paléont. univ. 1847, pl. lxxx. figs. 1-4; but I have not access to that work.

² This is a doubtful species; it has the aspect rather of a Cirripede than of a Rhyncholite.

³ Excellent figures of this species were published by d'Orbigny in his 'Cours Élémentaire de Paléontologie et de Géologie Stratigraphique,' vol. i. p. 271 (1849-1852), and the same figures were afterwards published by H. A. Nicholson in his 'Manual of Palæontology,' 2nd ed. 1879, vol. ii. p. 55, fig. 466; and again in the 3rd ed. of the same, 1889 (Nicholson and Lydekker), vol. i. p. 828, fig. 739.

⁴ *Rhynchoteuthis Dutemplei*, d'Orb., and *R. hasta*, *R. tuberculatus*, *R. undentatus*, Faure-Biguet, are all regarded by Pictet and Campiche (Pal. Suisse, sér. iii. pt. ii. 1862, p. 164) as doubtful species, being briefly described by Faure-Biguet. MM. Pictet and Campiche state also that the three last-named species may perhaps be Jurassic.

- Rhynchoteuthis quinquecarinatus*, Pictet and Campiche, Terr. Crét. de Sainte-Croix (Pal. Suisse, sér. iii. pt. ii.), 1862, p. 161, pl. lix. figs. 9, *a-c*.
- *Sabaudianus*, Pictet and de Loriol, Descrip. des Foss. Terr. Néocom. des Voirons (Pal. Suisse, sér. ii. pt. i.), 1858, p. 37, pl. viii. figs. 1, *a-d*, 2, *a-c*.
- Rhyncholithus simplex*, Fritsch, Cephalopoden der böhmischen Kreideformation, 1872, p. 25, tab. xi. figs. 4 *a*, 5 *a*, 5 *b*.
- Rhynchoteuthis Studeri*, Ooster, Catalogue des Céphalopodes Fossiles des Alpes Suisses, pt. ii. 1857, p. 12, tab. iv. figs. 8-10.
- *tuberculatus*, Faure-Biguet, Considérations sur les Bélemnites, 1819, p. 59. Also, d'Orbigny, Moll. Viv. et Foss. 1847, vol. i. p. 600.
- *unidentatus*, Faure-Biguet, loc. cit. p. 58. Also, d'Orbigny, loc. cit. p. 599.

TERTIARY.

- Rhyncholithes Allionii*, Bellardi, I Molluschi dei Terreni Terziari del Piemonte e della Liguria, 1872, pt. i. p. 22, tav. iii. figs. 2, *a-c*.

SUPPLEMENT¹.

Genus **ORTHOCERAS**².

SILURIAN SPECIES.

Orthoceras, sp.

This specimen (No. C. 2977) is a fragment of the septate part of the shell, partly hidden in the matrix. The shell tapers rather slowly; the section is circular; the septa are very numerous, there being 24 in the space of $2\frac{1}{2}$ inches. The siphuncle is not seen, and there is no trace of the test.

Horizon. Silurian (Lower Ludlow).

Locality. Mlaszkowce on the Sered (or Sereth), Galicia.

Presented by Dr. Szajnocha.

Orthoceras, sp.

Two fragments (No. C. 2976 & 2978) apparently belonging to the same species, but too imperfect to be determined specifically, may be thus described:—Shell very slightly curved. Transverse section circular. Rate of increase about 1 in 8. Body-chamber unknown. The distance between the septa increases slowly and somewhat irregularly; they are from 2 to $2\frac{1}{2}$ lines distant from each other where the diameter of the shell is about 13 lines; the sutures are slightly undulating. The siphuncle is central.

Remarks. The specimens here described are casts of the septate part of the shell, without any of the test remaining. They were presented to the British Museum (October, 1888), together with some other specimens of *Orthoceras*, by Professor Dr. Szajnocha of Cracow (Kraków). All the specimens are accompanied with labels

¹ Consisting of species added to the Collection during the progress of the present volume; together with some notices of recent works on the genera treated of in this, and the First Part of the Catalogue.

² See Part I. of the present Catalogue, p. 1.

upon which the names *Orthoceras Römeri*, Alth., and *O. podolicum*, Alth., are written. As I was unable to discover any record of these species in any of the Cracovian journals of science, I wrote to Dr. Szajnocha, to know if he could inform me where I might find them. He very kindly wrote to me, saying that they had been mentioned for the first time by the late Professor Dr. Alth in his memoir entitled "Ueber die Palæozoischen Gebilde Podoliens und deren Versteinerungen" (Abhandlungen der k. k. Geologischen Reichsanstalt, 1874, Band vii. Heft i. p. 1). On consulting this work I can find no such names as those above cited; but the occurrence of *Orthoceras* is frequently noted in the enumeration of the fossils of the Silurian rocks of Podolia.

Horizon. Silurian (Upper Ludlow ¹).

Locality. Zaleszczyky, on the Dniester, Galicia.

Represented in the Collection by two examples presented by Dr. Szajnocha.

***Orthoceras*, sp.**

A single fragment (No. C. 2979) of the septate part of an *Orthoceras*, too imperfect to be determined specifically, presents the following characters:—Shell straight. Transverse section circular. Rate of increase about 1 in 5. Body-chamber not preserved. Septa about 2 lines distant from each other where the diameter of the shell is 1 inch 5 lines. Siphuncle central, so far as can be ascertained, the specimen being divided longitudinally in an unequal manner. Indistinct traces of the siphuncle are seen, the elements of which appear to be bulbous.

Remarks. This specimen bears some resemblance to *Orthoceras curvescens*, Barrande ² (Syst. Sil. de la Bohême, vol. ii. sér. iii. 1868, Atlas, pl. cclvi.; also *ibid.* pt. i. texte, pt. iii. 1874, p. 183), but it differs in its closer septa and central bulbous siphuncle.

Horizon. Silurian (Upper Ludlow).

Locality. Zaleszczyky on the Dniester, Galicia.

Presented by Dr. Szajnocha.

***Orthoceras intermedium*, Barrande.**

1866. *Orthoceras intermedium*, (Marklin, MS.) Barrande, Syst. Sil. de la Bohême, vol. ii. sér. ii. pl. ccxxx. ff. 4-6.

¹ *Fide* Prof. Dr. Szajnocha.

² At first (1868) called *Cuvieri* by Barrande, who changed it, that name being preoccupied by Troost.

1874. *Orthoceras intermedium*, Barrande, *ibid.*, texte, pt. iii. p. 702.

1880. *Orthoceras intermedium*, Angelin and Lindström, *Fragmenta Silurica*, p. 7, tab. v. ff. 9-12.

1888. *Orthoceras intermedium*, Lindström, *List of the Fossil Faunas of Sweden*, ii. Upper Silurian, p. 7.

Sp. Char. Shell (cast) straight? Transverse section circular. Rate of increase about 1 in 12. Body-chamber unknown. Septa numerous; their distance from each other about $\frac{1}{6}$ of the shell-diameter. Sutures slightly undulating. Siphuncle excentric, situated at a point about two-fifths the distance across the diameter. The segments of the siphuncle vary in character, *i. e.* they are nummuloidal towards the smaller extremity of the shell, where their breadth is to their height as 7:4; at the larger end this ratio is reversed, their breadth in relation to their height being nearly as 4:7. The test is not known.

Remarks. This species may be compared with *Orthoceras Ludense*, J. de C. Sowerby (= *O. columnare*, Marklin, *O. Dahlii*, Barr.), but it is easily distinguished by its more numerous septa, and the peculiar variation in the form of the siphuncle.

Horizon. Upper Ludlow.

Locality. Island of Gothland, Sweden.

Represented in the Collection by a single example (No. C. 2874).

DEVONIAN SPECIES.

Orthoceras Chinense, Foord¹.

Since the description of this species was published in Part I. of the present Catalogue, a remarkably fine, almost perfect specimen, has been presented to the Museum. The test, hitherto unknown, may be pronounced to be smooth, as it is marked only with exceedingly fine, irregular transverse striæ. The rate of increase is rapid, nearly 1 in 9. The specimen is 3 feet $2\frac{1}{2}$ inches in length; its greatest diameter is 5 inches, its smallest $\frac{1}{2}$ an inch.

Horizon. Devonian?

Locality. 30 miles north of Ichang, in the province of Hoo-pe, China. Presented by N. M. Yankowsky, Esq.

¹ See Pt. I. of the present Catalogue, p. 100.

TRIASSIC SPECIES.

Orthoceras campanile, Mojsisovics.

1859. *Orthoceratites dubius* (pars), Stoppani, Les Pétrifications d'Esino ou Descriptions des Fossiles appartenant au Dépôt Triassique Supérieur des Environs d'Esino en Lombardie, p. 112, pl. xxiv. f. i. (*Fide* Mojsisovics).
1865. *Orthoceras* sp., v. Hauer, Cephalopoden der unteren Trias, Sitz.-Ber. d. k. k. Akad. d. Wissensch. zu Wien, p. 619.
1867. *Orthoceras* cf. *dubium*, Beyrich, Cephalopoden aus dem Muschelkalk der Alpen, Phys. Abhandl. d. k. Akad. d. Wissensch. zu Berlin (Jahre 1866), p. 138, Taf. iii. f. 3.
1869. *Orthoceras campanile*, Mojsisovics, Beiträge zur Kenntniss der Cephalopoden-Fauna des Alpenen Muschelkalkes, Jahrb. d. k. k. Geol. Reichsanstalt, p. 590.
1882. *Orthoceras campanile*, Mojsisovics, Die Cephalopoden der Meditteranen Triasprovinz, Abhandl. d. k. k. Geol. Reichsanstalt, Band x. p. 291, Taf. xciii. ff. 1-4, 11.

Sp. Char. Shell very long; slowly increasing, at the rate of about 1 in 13. Body-chamber very short, with a constriction near the aperture (well seen in the specimen numbered C. 3397a). Transverse section circular. Septa numerous, deeply concave, slowly increasing in their distance from each other; 3 lines apart where the shell has a diameter of 5 lines, increasing to 5 lines apart where the diameter of the shell (base of body-chamber) is 9 lines¹. Sutures horizontal. Siphuncle central, slender. Test smooth.

Remarks. Mojsisovics observes that *Orthoceras campanile* is distinguished from *Orthoceras elegans*, Münster, of which it is the precursor, chiefly by its much greater size.

Horizon. Upper Muschelkalk (zone of *Ceratites trinodosus*).

Locality. Schreyer Alpe, near Hallstadt, Upper Austria.

Fairly well represented in the Collection.

Orthoceras, sp. (Salter).

1865. *Orthoceras*, Salter, in Strachey's Palæontology of Niti in the Northern Himalaya, &c., p. 67, pl. viii. ff. 7-10.

Salter compared some imperfect fragments of a widely septate *Orthoceras* with much hesitancy to the *O. pulchellum* of v. Hauer

¹ These measurements are taken from one of Mojsisovics' figures (*loc. cit.* Taf. xciii. f. 1).

(Haidinger's Naturwiss. Abhandl. Band iii. p. 1, tab. i. ff. 1, 2), or, as an alternative reference, to the *O. salinarium* of the same author (Ceph. Salzkammergutes, 1846, p. 42, tab. xi. ff. 6-8). The specimens are, however, much too imperfect to warrant any conclusion as to their affinities.

Horizon. Upper Trias.

Localities. Gunges-gunga; Raj-hoti.

Represented in the Collection by Salter's type specimens.

Genus **ACTINOCERAS**¹,

Actinoceras striatum?, J. Sowerby, sp.

1814. *Orthocera striata*, J. Sowerby, Min. Conch. vol. i. p. 129, tab. lviii.

1877. *Orthoceras striatum*, de Koninck, Recherches sur les Fossiles Paléozoïques de la Nouvelle-Galles du Sud (Australie), p. 341, Atlas, pl. xxiv. ff. 2 a, 2 b.

1878. *Orthoceras striatum*, Etheridge, jun., Cat. of Australian Fossils, p. 90.

1888. *Actinoceras striatum*, Foord, Cat. of Fossil Cephalopoda in the British Museum (Nat. Hist.), pt. i. pp. 187, 190.

The specific characters of this species have already been given in Part I. of the present Catalogue (p. 190). De Koninck describes the Australian form as "very large, straight, conical, elongated, covered with very fine longitudinal ribs, partly interrupted and cut transversely by striæ of growth, a little oblique, and sometimes slightly undulating. Septa concave, subhemispherical, with straight sutures; siphuncle central, rounded, slightly infundibuliform, and having a diameter about a tenth of that of the septa. The distance of the septa varies a little with the progressive development of the shell . . . The body-chamber is very long and spacious . . ."

Remarks. The species differs from *Actinoceras striatum*, J. Sow., sp., in the possession of very distinct and regular transverse lines of growth, and therefore the identity of the Australian with the English species must be left in doubt. Perhaps the former may be a variety of the latter. The specimens are casts in a brown micaceous sandstone.

Morris² has described an *Orthoceras* from the Carboniferous rocks of New South Wales (Yass Plains), which may possibly be

¹ See Pt. I. of the present Catalogue, p. 164.

² In Strzelechi's 'Physical Description of New South Wales and Van Diemen's Land,' 1845, p. 921.

identical with the present form ; but the siphuncle is described as "nearly marginal," though this might have been due to crushing. Morris, in fact, remarks that his specimen was in such an imperfect state of preservation as to prevent the defining of any good specific character.

Horizon. Carboniferous.

Locality. Maitland, New South Wales.

Represented in the Collection by three specimens, one of which (No. C. 2932) was presented by C. Purdon Clarke, Esq. ; the others (No. C. 3395) were transferred from the Museum of Practical Geology.

Genus **HURONIA** ¹.

Huronia Portlocki, Stokes.

1840. *Huronia Portlockii*, Stokes, Trans. Geol. Soc. ser. ii. vol. v. pt. iii. p. 710, pl. lx. f. 5.

1866. *Orthoceras (Huronia) Portlocki*, Barrande, Syst. Sil. de la Bohême, vol. ii. sér. ii. pl. cccxxii. f. 4 (after Stokes).

1874. *Orthoceras (Huronia) Portlocki*, Barrande, *ibid.*, texte, pt. iii. p. 741.

1888. *Actinoceras spheroidale* (pars), Foord, Cat. of the Fossil Cephalopoda in the British Museum (Nat. Hist.), pt. i. p. 186.

Sp. Char. This species is represented by a fragment consisting of parts of eight chambers, with portions of seven segments of the siphuncle, weathered out of the hard limestone matrix. The specimen is 7 inches long, $2\frac{1}{2}$ inches at its widest, and about 2 inches at its narrowest extremity. The rest of the shell is represented only by casts of the chambers, showing the position of the sutures and the boundaries of the shell-wall. The septa are 8 lines distant from each other, where the diameter of the specimen is $2\frac{1}{2}$ inches. A cross-section of one of the segments of the siphuncle is seen at the larger extremity of the specimen ; this shows that the segments are nearly circular in a horizontal direction, but they are compressed vertically, so that they have a cushion-like form.

Remarks. This species most nearly resembles *Huronia obliqua*, Stokes ², but it differs in the perfect horizontality of its siphuncular segments, and in the greater distance of the septa from each other.

¹ See Pt. I. of the present Catalogue, p. 199.

² Trans. Geol. Soc. 1824, ser. ii. vol. i. pt. ii., explanation of pl. xxviii. f. 4 ; and p. 203, Species iv. of Bigsby.

In Part I. of the present Catalogue (p. 186), I erroneously referred this species to *Actinoceras spheroidale*, Stokes ¹.

It may be mentioned that there are two more segments in the type specimen of *Huronina Portlocki* than are figured by Stokes. The top part of the specimen being broken off was probably overlooked when the drawing was made; it is now united to the main mass.

Horizon. Niagara Group (Wenlock).

Locality. Drummond Island, Lake Huron.

Represented in the Collection by the specimen (No. 33418) figured by Stokes.

Subgenus **MELOCERAS** ².

Cyrtoceras (Meloceras) impotens, de Koninck.

1880. *Cyrtoceras impotens*, de Koninck, Faune du Calc. Carbonifère de la Belgique (Ann. du Mus. Roy. d'Hist. Nat. de Belgique, vol. v.), pt. ii. p. 28, pl. xxxv. ff. 8, 8 a.

Sp. Char. Shell of moderate size, slightly arcuate, increasing slowly in diameter. Transverse section circular. Septa rather shallow; wider apart than they are generally in species of this size, being $3\frac{1}{2}$ lines distant from each other where the shell diameter is 11 lines. The siphuncle, which appears to be nummuloidal, is situated a little excentrically, towards the ventral side; it is relatively thick. The test is thin, with a smooth surface.

Remarks. Only one large fragment, consisting of nearly the whole of the septate part of the shell, was known to M. de Koninck. The species most nearly allied to *C. impotens* was judged by de Koninck to be his *C. deflexum*, which is, however, distinguished by its considerably smaller size and cylindrical siphuncle.

Horizon. Carboniferous Limestone.

Locality. Ireland.

Represented in the Collection by a single example.

ASCOCERATIDÆ ³ and **LITUITIDÆ** ⁴.

In Part I. of the present Catalogue ⁵ (1888), reference was made to the important discovery by Dr. Gustav Lindström, in the Silurian rocks of the Island of Gothland, of the missing part of the shell of

¹ Bigsby, Trans. Geol. Soc. 1824, ser. ii. vol. i. pt. ii. p. 203, and explanation of plate xxviii. f. 5.

² See Pt. I. of the present Catalogue, p. 269.

³ See Pt. I. of the present Catalogue, p. 246.

⁵ Supplement, p. 334.

⁴ See *suprà*, p. 1.

Ascoceras. Dr. Lindström, having lately completed his researches in this and kindred genera, has embodied them in a richly illustrated memoir written in English, and entitled "The Ascoceratidæ and the Lituitidæ of the Upper Silurian Formation of Gotland." This was communicated to the Royal Swedish Academy of Sciences¹, 11th Dec. 1889, and was published in the Proceedings of that institution for 1890. Most of the observations and descriptions which follow are given in Dr. Lindström's words, only a few passages, not deemed to be of primary importance, being omitted.

Dr. Lindström divides the family *Ascoceratidæ* into four genera—*Ascoceras*, Barrande²; *Glossoceras*, Barr.³; *Billingsites*, Hyatt⁴; and *Choanoceras*, gen. nov.

The common feature in their structure, that unites all these genera, is the abnormal growth and morphology of the septa formed during the last stage of their existence. Having begun with regularly formed septa, the later ones are bent obliquely in a sort of high saddle towards one of the sides (fig. 84, A), and all that succeed the first sigmoid septum are incomplete or leave a large lacuna in their central part (fig. 84, C, D), which lacuna is framed by the lateral borders of the septa. The siphuncle is broad, with nummuloidal or bulbous elements. The first three genera have attained a more pronounced development of the characteristic structure, which has been coming on by degrees in *Choanoceras*, without such a sudden transition from a Nautiloid stage as in them. A common feature in them all is the truncation, which seems to have been repeated several times.

The systematic position and the affinities of this family have long been a puzzle, at least, as long as the last stage of growth was the only one known. As Barrande left this group, it consisted of the two genera *Ascoceras* and *Glossoceras*, he himself having declared that *Aphragmites* could not any longer be retained as a distinct genus, and that both its species coincided with true *Ascoceras* forms.

¹ Kongl. Svenska Vetenskaps-Akademien's Handlingar, Bandet 23, No. 12, Stockholm, 1890.

² Oesterr. Blätt. für Litt. u. Kunst, 1847; Haidinger's Berichte über d. Mittheil. v. Freund. d. Naturwiss. in Wien, 1847, p. 268; also Bull. Soc. Géol. France, 1855, sér. ii. vol. xii. p. 157.

³ Syst. Sil. de la Bohême, 1867, vol. ii. pt. i. p. 372.

⁴ "Genera of Fossil Cephalopods," Proceed. Boston Soc. Nat. Hist. vol. xxii. 1883, p. 278. *Billingsites* is a Silurian genus closely allied to *Ascoceras*. The type species is *Asc. Canadense*, Billings, Rep. Prog. Geol. Surv. Canada, 1853-56, p. 310.

Barrande regarded this family as equal in importance to the large families of the *Nautilidæ* and the *Goniatitidæ*, and gave it a collateral place as the third family of the Bohemian Cephalopoda. He

Fig. 84.



A, schematic view of the interior of *Ascoceras manubrium*, Lindstr., showing the structure and arrangement of the septa: *si*, siphuncle; *dt*, duct that communicates with the siphuncle of the Nautiloid portion of the shell (*n*, fig. F). B, schematic view of three sigmoid septa of *Ascoceras fistula*, Lindstr., seen from the ventral side. C, view of the third septum of the same species, shown as free, as if detached from the shell, to exhibit the large central lacuna. D, the same, viewed laterally (the siphuncular orifice is seen at the bottom of all these figures). E, longitudinal section of a specimen of *Asc. decipiens*, Lindstr., from Sandarfve kulle (hill), with four regular septa above the sigmoid ones. F, schematic view of *Asc. decipiens*, represented as if complete; *n*, the Nautiloid portion of the shell. G, longitudinal and median section from the concave to the convex side of *Choanoceras mutabile*, Lindstr., showing the interior of the shell, with the outlines of the incomplete septa; *si*, siphuncle. H, fragment of the same species, reduced to about $\frac{1}{3}$ natural size.—All the figures are copied from Lindström's plates: A–D are reduced by camera from about $\frac{1}{3}$ to $\frac{1}{2}$ natural size; E–G are the size of the original figures¹.

has been followed in this respect by Fischer in his recent 'Manuel de Conchyliologie.' But nearly all the other authors, who have

¹ The above figures are taken from plates iii., v., and vi. of Lindström's memoir on 'The Ascoceratidæ and Lituitidæ of the Upper Silurian Formation of Gotland' (Stockholm, 1890).

mentioned these fossils in their memoirs or manuals (viz., Billings, Giebel, Wiltshire, Wright, Blake, Zittel, and Foord) have placed the *Ascoceratidae* close to *Gomphoceras*. This has in some respects been caused by the accidental similarity of the truncation, and in some degree by the inflated shell in these genera, which also seems to have led some authors to accept the idea that *Ascoceras*, and still more *Aphragmites*, was in its entirety the living chamber of the animal. Ferd. Roemer places *Ascoceras* next to *Trochoceras*, Bronn and Woodward next to *Gyroceras*, Philippi between *Lituites* and *Cyrtoceras*, while Nicholson includes it within his family of the *Orthoceratidae*.

Hyatt, disregarding the fundamental similarity in structure, placed his own genus *Billingsites* amongst the *Mesoceratidae* and the other genera in the family of the *Ascoceratidae*, and both these families next each other between the *Gomphoceratidae* and the *Melonoceratidae*. There is no valid ground to separate *Billingsites* from the *Ascoceratidae*, and join it with *Mesoceras*. This latter genus, which was founded by Barrande on a single specimen—none having since his day been found—is known only by the living chamber, which closely resembles that of the *Gomphoceratidae*, with which group also Fischer and Foord have united it. There is no evidence whatever [in *Mesoceras*] of septa like those of *Ascoceras*, and there is consequently no foundation for placing it with the *Ascoceratidan* genus *Billingsites*.

Hyatt also included *Ophidioceras* amongst the *Ascoceratidae*, because "the costated compressed whorls have some resemblance to those of *Ascoceras*, and the aperture is closely similar to *Glossoceras*." The exterior resemblance, as to the ornamentation, is very slight, if any, and the similarity of the aperture is of no significance when the most important character, the sigmoid septa, is wanting. The arrangements of Hyatt must then be changed thus,—that *Billingsites* is to be placed amongst the *Ascoceratidae* near *Glossoceras*, on account of its contracted aperture, while *Ophidioceras* may keep its more natural place, which has been given it by Barrande, amongst the *Lituitidae*. Strangely enough, Hyatt has re-established *Aphragmites* in spite of its disavowal by its own author, Barrande. Hyatt thinks "it is a distinct genus with simple septa and sutures." According to Barrande its chief characteristic should, however, consist in its total want of septa, which also is indicated by its name.

Ascoceras.—This remarkable genus is during a long period of its life Nautiloid as to the structure of its shell, and at last changes into

that shape which for so long a time has been alone known as the *Ascoceras*. There are thus two stages to be taken into consideration separately in a description, viz. (1) the Nautiloid; (2) the *Ascoceras* proper.

(1) The Nautiloid (Fig. 84, F, *n*).—I have called this stage so, because it corresponds with the common type of the suborder of the Nautiloidea. It cannot properly be called an Orthoceratite stage as the shell is not straight, but curved and thus rather a *Cyrtoceras*, having also the siphuncle formed in accordance with that genus. If it ever was quite entire and intact, before attaining its last [*Ascoceras*] stage, the shell has been bent in a large arch (fig. 84, F, *n*); but it is evident that it broke off and was decollated several times during its growth. In some species (*Asc. fistula*), the Nautiloid part was straighter, though slightly curved. The thin shell, which only slowly widened, is generally transversely striated or annulated, with slight modifications in the different species. The interior structure is highly uniform in all, with oblique watchglass-like septa, higher on the dorsal side than on the ventral; placed at very irregular distances from each other, sometimes close, sometimes wide apart, the distance increasing with the augmenting width of the shell. The siphuncle is always placed near the ventral side, and consists of tubular, narrow elements, enclosed in a calcareous sheath of their own, and connected with the funnel of the downwardly curved septal aperture [neck]. In some there is a tube on the upper surface of the septum, which encloses the base of each siphonal element.

2. The *Ascoceras* proper (Fig. 84, A, E, and upper part of F).—The shell, often pyriform or flask-shaped, consists of two different portions—the lower or larger, usually wider portion, containing the septa, and its more narrow, neck-like continuation, ending with the round aperture. The shell is almost always flattened from two opposite sides, in the lower or essential portion with an ovate section, and cylindrical in the neck with circular section. There are two different sorts of septa: (1) Regular, Nautiloid septa; (2) Sigmoid, *Ascocerate* septa proper. The first septum, which may be regarded as the last Nautiloid septum and forms the bottom of the shell, is strengthened from within by organic deposits of calcareous matter. It is in a distinct group of species followed by a second septum of regular shape; but in the majority of species the abnormal sigmoid septa follow immediately on the first. The number of the sigmoid septa varies from three to seven, but is very constant in the same species. A fragmentary specimen of an unknown species has indications of no less than twelve septa. The septa are continuous

from the ventral to the dorsal side, as may be seen in many casts, where the sutures continue uninterruptedly across the shell. But in the interior of the shell this continuity is broken (fig. 84, B, C, D). There it is seen that the first sigmoid septum alone is entire, and all the following are open or lacunose along their centre; the organic deposit has not been secreted there (fig. 84, A-D). The deposition ceased where a septum has touched the surface of a preceding septum, but around the margins, where they do not meet, all are entire. The margins thus form a sort of frame around a central, empty space, and there is a sort of imbricate arrangement of them in their position relatively to each other. In a certain way the curvature of the septa may, as Hyatt has remarked, be compared with the saddle of the septa in *Goniatites*, though much more exaggerated in *Ascoceras*. Moreover, on the interior of the dorsal side in the shell the septa form a semicircular sinus, so that they are widest along the sides and most restricted in the middle. The siphuncle, always near the ventral side, consists of one element less than the number of the septa, and the elements are almost always broad, nummuloid, and rapidly increasing in breadth upwards. This siphuncle is in immediate connection with the siphuncle of the Nautiloid part of the shell through a peculiar little tubular duct (fig. 84, A, *dt*), which is different in each species, and is closed with a calcareous secretion when decollation has taken place. The earlier septa are more distant from each other than the later or upper ones, the distance between the first and second, and between the second and third being the greatest. In the central part of the shell, the second, third, and fourth septa advance furthest, and the uppermost are the narrowest and most receding (fig. 84, A). In *Glossoceras*, again, there is a steady increase in breadth, and the uppermost septa are the most prominent of all. The form and position of the septa (fig. 84, A) may be thus described: commencing at the dorsal wall of the shell they first make a strong, inwardly-directed curve, and then sweeping outwards in a wider curve, they closely approach the dorsal side and finally bend round to the ventral side, thus completely encircling the shell.

Dr. Lindström questions whether there was any important change in the animal of *Ascoceras*, such as the altered form of the septa in the *Ascoceras* stage would appear to indicate. That there was some change, at least in volume, may be reasonably supposed, because it is evident that the form of the shell must have been governed, to a great extent, by that of the animal's body. But in several cases there is evidence, in the shape of the septa and siphuncle of the

Ascoceras stage, of a curious reversion to the Nautiloid stage (fig. 84, E). From this "reversion of character" Dr. Lindström concludes that as the animal could hardly "twice modify its body," there can have been but little change in its structure in passing from the Nautiloid into the Ascoceras stage of its existence.

Specimens are figured by Dr. Lindström showing that the Ascoceras shell as a continuation of the Nautiloid shell was sometimes completed without any septa.

Dr. Lindström considers that there can be no doubt that the shell of *Ascoceras* was external and enclosed the animal. The richly ornamented surface, the long body-chamber in the Nautiloid part, and the deposit of calcareous matter from within, after decollation, testify clearly to this fact. In the shell of *Spirula*, which is only partially enclosed by the mantle of the animal, there is no external sculpture, nor is the uppermost chamber larger than the others, a living chamber not being required. Dr. Lindström believes that an increase in the body of the animal in such genera as *Gomphoceras* and *Poterioceras* must have occurred; he adds that the last named bears no slight resemblance to *Ascoceras*. He considers that the secretion of the sigmoid septa was begun after the shell had been completed, and the mollusc had drawn itself higher up in it.

Thirteen new species of *Ascoceras* are described and figured by Dr. Lindström, viz:—*cochleatum*, *dolium*, *fistula*, *pupa*, *reticulatum*, *manubrium*, *ampulla*, *collare*, *lagena*, *cucumis*, *decipiens*, *sipho*, *gradatum*.

The new genus *Choanoceras*¹ (fig. 84, G, H) is described as having a shell "resembling a faintly curved Orthoceratite, with the lower extremity truncated and conically pointed." The aperture is probably simple; the body-chamber very large, occupying almost nine-tenths of the whole shell. Septa from four to six, formed like a pointed, oblique funnel. All the septa are equally well developed in young specimens, but in the adult, in which there are six septa, three of these are complete, and the three earlier ones incomplete or lacunose. The siphuncle is nummuloid in the older individuals, cylindrical in the younger, and the necks of the septa hook-like and strongly recurved. This genus differs from *Ascoceras* in the slight development of its lacunose septa. The position of the latter appears also to be contrary to that of *Ascoceras*, supposing the convex side of the shell to be the ventral, and the concave the dorsal, as is assumed to be the case in *Ascoceras*. In *Choanoceras* the

¹ From *χόανος*, a funnel.

lacunose septa are placed against the convex side; in *Ascoceras* against the concave side. Only one species of *Choanoceras* is known, viz. *C. mutabile* (fig. 84, G, H).

Dr. Lindström considers that *Billingsites*, Hyatt (placed by that author with *Mesoceras* in the family *Mesoceratidæ*, Hyatt), should be "placed amongst the *Ascoceratidæ* near *Glossoceras*, on account of its contracted aperture, while *Ophidioceras* may keep its more natural place amongst the *Lituitidæ*, which has been given to it by Barrande."

Under the *Lituitidæ*, Dr. Lindström describes two species of *Ophidioceras* (see p. 8 of this volume), viz. *O. reticulatum*, Angelin, and *O. rota*, sp. nov. He remarks that there is nothing to be added to the generic characters of the genus as laid down by previous authors, except that the body-chamber is of extreme length in all the Gothland species sectioned. It occupies more than one whorl, and sometimes even exceeds two.

Since the earlier pages of the present volume were in type, treating of the *Lituitidæ* (see pp. 1-14), an important memoir has been published by Dr. Adolf Remelé, entitled "Untersuchungen über die Versteinerungsführenden Diluvialgeschiebe des norddeutschen Flachlandes, mit besonderer Berücksichtigung der Mark Brandenburg," i. Stück, 3 Lief., Berlin, 1890; pp. 108, plates 1-6. In Part i. of this paper the author describes and figures the following species of *Lituites*, viz. :—

- L. lituus*, Montfort,
- L. perfectus*, Wahlenberg,
- L. Hageni*, sp. nov.,
- L. Decheni*, sp. nov.,
- L. heros*, sp. nov.,
- L. applanatus*, sp. nov.,
- L. Danckelmanni*, sp. nov.,

And one species of *Palæonautilus*, *P. hospes*, sp. nov.

Part ii. treats of the geometrical form of the shell, its sculpture, structure, &c.; concluding with a tentative classification of the different genera and subgenera included by Remelé in the family *Lituitidæ*.

Genus **LITUITES** ¹.[See *suprà*, p. 1.]**Lituities lituus**, Montfort.[See *suprà*, p. 5.]

A fragment (No. C. 3394) of the body-chamber of this species has just been brought to my notice. It is a cast, but it has some small pieces of the test remaining, showing fine and regular transverse thread-like lines, of which about five fill the space of 1 line. Part of the aperture is preserved and exhibits one of the curious lobes or lappets characteristic of the genus. The specimen is 4 inches long; $1\frac{1}{2}$ inches in diameter at the aperture, and about 1 inch at the posterior extremity. The cast is marked with strong transverse undulations, which are very irregularly waved, sometimes arching forwards in the direction of the aperture. The undulations vary in their distance apart from 1 to 2 lines; they are crowded together near the aperture.

L. lituus has lately been figured and described by Dr. Adolf Remelé in the work above mentioned:—‘Untersuchungen über die Verstein. Diluvialgeschiebe des norddeutschen Flachlandes,’ i. Stück, 1890, p. 7, Taf. i. ff. 1 a, 1 b.

Horizon. Oskarskal Group, 4 (= Bala?).

Locality. Sandvigen, Norway.

Transferred from the Museum of Practical Geology.

Genus **PLEURONAUTILUS**.[See *suprà*, p. 134.]**Pleuromutilus trinodosus**, Mojsisovics.

1882. *Pleuromutilus trinodosus*, Mojsisovics, Die Cephalopoden der Mediterranen Triasprovinz (Abhandl. der k.-k. geol. Reichsanst. Band x.), p. 274, Taf. lxxxv. ff. 1 a, 1 b.

Sp. Char. Shell thick, discoid, consisting of two and a half or three slightly embracing whorls, which are subquadrangular in section, the dorsal side a little broader than the periphery. Umbilicus shallow, with steep subangular sides; about two fifths the

¹ It will be convenient here to supply an omission in my remarks on this genus (*suprà*, p. 3), viz., to say that, as here restricted, *Lituities* is probably confined to the Ordovician rocks; its presence in the Silurian seems very doubtful (see *suprà*, p. 8).

greatest diameter of the shell. Septa numerous, moderately concave; sutures forming a shallow, backwardly-directed sinus on the sides of the shell, then inclining forwards and passing over the periphery with a slight median sinus. Siphuncle not observed. The flattened sides of the whorls are ornamented with transverse ribs radiating from the umbilicus, and abruptly terminating at the subangular edge of the periphery. The ribs are crossed by three rows of prominent, elongated nodes, those on the edge of the periphery being the largest. The periphery of the adult shell is broadly and evenly rounded, but that of younger shells exhibits a slight depression in the median line, caused by the pressure of the succeeding whorls. This depression is not shown in Mojsisovics's figure, which represents a much larger shell than the one in the British Museum, from which the present description is, in the main, drawn up. The whole of the test is covered with fine subregular lines of growth, which form a deep, backwardly-directed sinus in passing over the periphery. The lines of growth are crossed by fine thread-like lines, the two series, seen under a lens, exhibiting a beautifully cancellated appearance.

Remarks. This species is nearly related to *Pleuronautilus Mosis*, Mojs. (see *suprà*, p. 135, fig. 22), but differs from it in possessing three rows of nodes upon the ribs, which latter are also much less numerous in *P. trinodosus* than they are in *P. Mosis*.

Horizon. Zone of *Trachyceras Aonoides* (beds with *Lobites ellipticus*); Karnische Stufe, Alpine Trias¹.

Locality. Feuerkogel, near Aussee, Upper Austria.

Represented in the Collection by a single example (No. C. 3431).

Subgenus **HERCOGLOSSA.**

[See *suprà*, p. 180.]

Nautilus (Hercoglossa) Sauperi, Mojsisovics.

[See *suprà*, p. 185.]

Several specimens of this species having been added to the Collection, I take this opportunity of amending the description given on p. 185 of the present volume, as respects the sutures. The form of the latter is not clearly shown in Mojsisovics's figures,

¹ See Mojsisovics, "Ueber die Gliederung der oberen Triasbildungen der östlichen Alpen," Jahrb. der k.-k. geol. Reichsanst. 1869, Band xix. p. 91; also Credner, 'Elemente der Geologie,' 6th ed. 1887, table, p. 586.

owing to the test covering them, and the specimen available at the time when I drew up my description is in a very worn condition. The new specimens, on the other hand, show all the characters of the sutures, which are well seen on one of the specimens (No. C. 3429) in places where the test has been accidentally broken off. Instead of forming a "shallow sinus on the sides of the shell," &c., the sutures on leaving the umbilicus form a narrow, forwardly-directed, tongue-like lobe, then a wide, backwardly-directed sinus, and finally arching forward again they pass over the narrow, somewhat flattened periphery, on which they make a very slight, backwardly-directed sinus. This conformation of the suture-line being distinctly characteristic of *Hercoglossa*, I beg now to be permitted to place the present species in that subgenus.

Horizon. Zone of *Trachyceras Aonoides*; Karnische Stufe, Alpine Trias.

Localities. Feuerkogel, near Aussee, Raschberg, near Goisern, Upper Austria.

Well represented in the Collection (Nos. C. 3426-3430).

Genus **NAUTILUS.**

[See *suprà*, p. 179.]

Nautilus Saussureanus ?, Pictet.

1847. *Nautilus Saussureanus*, Pictet, in Pictet & Roux, Moll. Foss. des Grès Verts des Environs de Genève, p. 17, pl. i. ff. 3, a-c.

1858. *Nautilus Saussureanus*, Ooster, Cat. des Céphalopodes Fossiles des Alpes Suisses, pt. iii. p. 12.

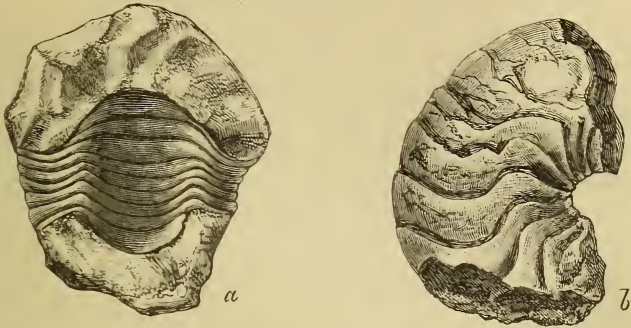
A fragment (No. 62471) consisting of portions of three chambers is referred with some doubt to Pictet's species, owing to its bad state of preservation. A label accompanies the specimen, bearing the name of the species, and its formation and locality, viz., Grès Vert; Saxonet, near Bonneville, Savoy.

Nautilus Mokattamensis, Foord.

[See *suprà*, p. 329.]

A figure of this species is here appended by which its characters may be more easily recognized. The figure should have accompanied the description (*suprà*, p. 329). The same observations apply to *Nautilus (Hercoglossa) Ægyptiacus*, figured below.

Fig. 85.

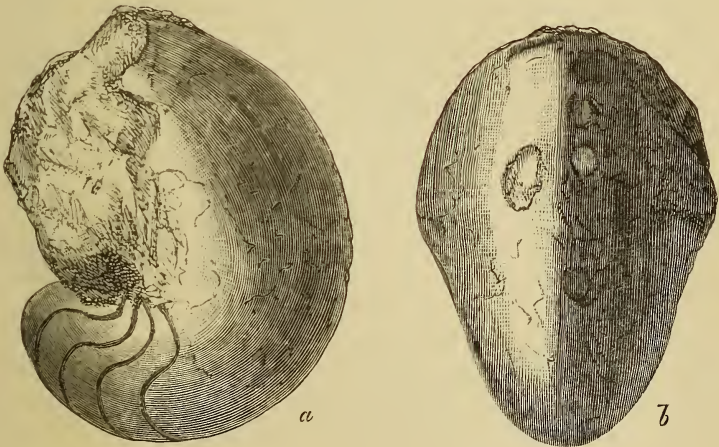


Nautilus Mokattamensis.—*a*, front view of a fragment, showing breadth of the whorls; *b*, lateral view, showing the wavy sutures. A little less than half natural size. (No. C. 3404.)

***Nautilus (Hercoglossa) Ægyptiacus*, Foord.**

[See *suprà*, p. 334.]

Fig. 86.



Nautilus (Hercoglossa) Ægyptiacus.—*a*, lateral view, showing the body-chamber and sutures; *b*, peripheral view, showing the subangular form of the periphery. Rather less than one fourth natural size. (No. 70378.)

NOTES AND EMENDATIONS.

The recent publication of a valuable Monograph of the Devonian Fauna of the South of England¹ (Pal. Soc. 1890—vol. for 1889) by the Rev. G. F. Whidborne throws new light upon many of the species of Cephalopoda from that region, new and better specimens than Phillips had at his disposal having been available for the work. Having had the opportunity, kindly afforded me by Mr. Whidborne, of examining several of the specimens from his collection, I am enabled to make a few corrections in the identification of one of the species described in the earlier part of the present volume. In the synonymy of *Gyroceras Eifelense*, d'Arch. & de Vern., sp. (*suprà*, p. 59), I have included, though doubtfully, the *Cyrtoceras nautiloideum* of Phillips. On a re-examination of Phillips's specimen, in company with Mr. Whidborne, I have come to the conclusion, with him, that the last-named species is most probably identical with *C. [Gyroceras] armatum*, Phillips². (See Mr. Whidborne's memoir, p. 99.) The *C. nautiloideum* of Phillips is described by Mr. Whidborne as a "very much worn cast." . . . "only distinguishable from the other shells by the general (not entire) absence of nodes, and by its more regular section. These differences," continues Mr. Whidborne, "may, however, be fully accounted for by the great amount of surface-decay which it has undergone, if not also by such specific variation as we have already observed in *G. præclarum* [Whidborne, = *C. ornatum*, Phil., not Goldfuss]."

The following new species of Nautiloidea are described by Mr. Whidborne³:—*Temnocheilus inornatus* (= *Hercoceras inornatum*, Whidb. Geol. Mag. dec. iii. vol. vi. p. 29), *Trochoceras Foordianum*, *Trochoceras Vicarii* (= *Cyrtoceras Vicarii*, Whidb. Geol. Mag. dec. iii. vol. vi. p. 29), *Trochoceras pulcherrimum* (= *Cyrtoceras pulcherrimum*, Whidb. Geol. Mag. dec. iii. vol. vi. p. 29), *Gyroceras præclarum* (= *Cyrtoceras ornatum*, Phil., not Goldfuss, and *Cyrtoceras præclarum*, Whidb. Geol. Mag. dec. iii. vol. vi. p. 29), *Gyroceras asymmetricum*, *Gyroceras Crickii*, *Gyroceras Leei* (= *Cyrtoceras Leei*, Whidb. Geol. Mag. dec. iii. vol. vi.

¹ Part ii., "The Fauna of the Limestones of Lammaton, Wolborough, Chircombe Bridge, and Chudleigh," pp. 47-154, pls. v.-viii., viii. A, ix.-xv.

² Figures and Descriptions of the Palæozoic Fossils of Cornwall, Devon, and West Somerset, 1841, p. 118, pl. xlviii. ff. 225, a-c.

³ I have placed them in the order in which they occur in his memoir.

p. 29), *Cyrtoceras difficile*, *Cyrtoceras*, "n. sp.,"¹ *Cyrtoceras Robertsii*, *Phragmoceras* ? *ungulatum*, *Poterioceras vasiforme* (= *Gomphoceras vasiforme*, Whidb. Geol. Mag. dec. iii. vol. vi. p. 29), *Poterioceras Marri* (= *Gomphoceras Marri*, Whidb. Geol. Mag. dec. iii. vol. vi. p. 29), *Gomphoceras poculum* (? = *Orthoceratites subfusiformis*, d'Arch. & de Vern., not Münster), *Actinoceras Devonicans* (= *Orthoceras Ludense*, Phil., not J. de C. Sowerby), *Orthoceras eutrichum* (= *Orthoceras comatum*, Whidb. Geol. Mag. dec. iii. vol. vi. p. 29), *Orthoceras Robertsii* (cf. *Orthoceras irregulare*, Münster.), *Orthoceras Vicarii*, *O. Vicarii* var. *eductum*, *Orthoceras dolatum* (= *Orthoceras tubicinella*, Sandberger, not J. de C. Sowerby; and *Orthoceras hastatum*, Whidb. Geol. Mag. dec. iii. vol. vi. p. 29), *Orthoceras subtubicinella*, *Orthoceras Oryx* (= *Orthoceras Ibe*x, Phil., not J. de C. Sowerby), *Orthoceras Champernowni* (= *Orthoceras imbricatum*, Phil., not Wahlenberg).

Some sections of *Orthoceras* contained in two small polished slices of limestone (No. C. 2167) were referred to in Part I. (p. 103) as possibly belonging to a Carboniferous species, *O. cylindraceum*, Fleming; they turn out, however, to be of Silurian age, and are apparently identical with fragments of unknown species contained in a large polished slab of *Orthoceras*-bearing limestone (No. C. 2729), from the quarries near Kosoř and Slivenec, Bohemia. The rocks in these places belong to Barrande's Étage E 2. The slab in question is now mounted and set up in the Cephalopoda Gallery.

Referring again to Part I. (Supplement, p. 326) it will be noticed that I have placed *Jovellania* among "Genera of doubtful Affinities." Since the publication of that Part, M. Charles Barrois has published an important work entitled "Faune du Calcaire d'Erbray (Loire Inférieure)"². In this work M. Barrois constitutes *Jovellania* a subgenus of *Orthoceras*, but without giving any description of it. He, however, describes a new species (*J. Davyi*)³ and compares another to *J. Kochi*, Kayser⁴, ranking the first (*J. Davyi*) in

¹ I venture to think that the author would have done well to have named this species, as he appears to have made out a very good case for its being a new one.

² Lille, 1889.

³ *Loc. cit.* p. 224, pl. xvi. fig. 1.

⁴ Abhandl. zur geol. Spezialkarte von Preussen, Band ii. Heft iv. 1878, p. 69, Taf. ix fig. 3.

Group ii. section ii. of Barrande¹ (= *Jovellania* of Bayle), which includes forms characterized by the triangular contour of their transverse section, their numerous air-chambers, and by the radiating lamellæ filling their siphuncle and representing the organic deposit. M. Barrois adds that this section has for its type the *Orthoceras triangulare*, d'Arch. and de Vern.², and comprehends the following forms :—

- Orthoceras Archiaci*, Barr.³,
- *victor*, Barr.⁴,
- *Jovellani*, Vern.⁵,
- *triangulare*, Roemer⁶,
- *Buchii*, Vern.⁷,
- *Losseni*, Kayser⁸,
- *Kochi*, Kayser⁹;

and to these may be added some of the species enumerated under my description of *Jovellania*¹⁰, viz. *Orthoceras Murrayi*, Billings¹¹, *O. capitolinum*, Safford¹², and (?) "*Gomphoceras*" *Hesperis*, Eichwald¹³.

I must here point out that in constituting *Orthoceras triangulare*, d'Arch. and de Vern.¹⁴ (not Roemer), as the type of *Jovellania*, M. Barrois is in error, since Bayle himself selected *O. Buchi*, Vern., as the type¹⁵.

I cannot agree with M. Barrois's allocation of *Jovellania* as a subgenus of *Orthoceras*, as I share the opinion expressed by Kayser¹⁶

¹ Syst. Sil. de la Bohême, vol. ii. pt. iii. 1874, p. 102, pl. ccli.

² Trans. Geol. Soc. ser. ii. vol. vi. 1842, p. 347, pl. xxvii. figs. 1, 1 a.

³ Syst. Sil. de la Bohême, vol. ii. pt. iii. 1874, p. 102.

⁴ Ibid. p. 104.

⁵ Bull. Soc. Géol. de France, 1845, sér. ii. vol. ii. p. 461, pl. xiii. figs. 1 a, 1 b, 2.

⁶ Beitr. z. Kenntn. des nordwestl. Hartzgebirges, 1850, p. 64, Taf. x. [misprinted v. in text] figs. 6. a, b.

⁷ Bull. Soc. Géol. de France, 1850, sér. ii. vol. vii. p. 778.

⁸ Abhandl. zur geol. Specialkarte von Preussen, Band ii. Heft iv. 1878, p. 68, Taf. ix. fig. 1.

⁹ Ibid. p. 69, Taf. ix. fig. 2.

¹⁰ Cat. Foss. Ceph. British Museum (Nat. Hist.), 1888, pt. i. p. 327.

¹¹ Geol. Surv. Canada, Rep. of Progr. for the years 1853–1856 (1857), p. 332.

¹² Geol. of Tennessee, 1869, p. 290, pl. iv. (G 3) figs. 1 a, 1 b (excl. 1 c).

¹³ Leth. Ross. vol. i. p. 1270, pl. xlix. figs. 4 a–c and 8 a–c.

¹⁴ Trans. Geol. Soc. ser. ii. vol. vi. 1842, p. 347, pl. xxvii. figs. 1, 1 a.

¹⁵ Bull. Soc. Géol. de France, sér. iii. vol. vii. Jan. 1879, p. 91.

¹⁶ Abhandl. zur geol. Specialkarte von Preussen, Band ii. Heft iv. 1878, p. 66.

that the characters of *Jovellania* indicate affinities with the Cyrtocerata of the Eifel, and some of those of the Bohemian Étages E and G, rather than with *Orthoceras*.

Under these circumstances I consider that it would be advisable to constitute a separate family—*Jovellaniidae*—for the reception of *Jovellania*, as I suggested in Part I. of the present Catalogue Supplement, p. 328).

Nautilus Dekayi, Morton. [See *suprà*, p. 305.] Some interesting examples of this species (Nos. C. 3413–3417) have been recently added to the Collection; presented by E. S. Cameron, Esq. They include very young, adolescent, and adult individuals, as well as several detached septa; all undoubtedly belonging to Morton's species, as interpreted by F. B. Meek. The smallest specimen is about 1 inch in its greatest diameter, and 10 lines in its greatest breadth. The largest (a body-chamber, with one septum attached) is about 4 inches in its greatest diameter, and $3\frac{3}{4}$ in its greatest breadth. Remains of the test adhere to the cast in this and the other specimens. They are all from the Cretaceous rocks of the "Powder River Range," Montana.

The exact division of the Cretaceous from which they were derived is not known with certainty, but they are either from the Fort Pierre or the Fox Hills Group, these being the divisions in which *Nautilus Dekayi* is recorded by Meek¹ from the Cretaceous rocks of Nebraska.

¹ Rep. United States Geol. Surv. Terr. vol. ix. 1876, p. xxiv.

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